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Report of Progress in Solving Idaho's Farm Problems

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Foreword

C. W. HUNGERFORD, *Vice Director*

THE functions of the College of Agriculture of the University of Idaho are served by three divisions: instruction, by the resident teaching faculty; extension, by the Extension Division; and research, by the Agricultural Experiment Station. Since the establishment of the Station in 1892, agricultural research has been organized, developed, and expanded to meet the needs of the farmers of the various farming areas of the State.

Investigations now are conducted not only in laboratories and greenhouses and on the 750-acre farm of the home station at Moscow, but also on the branch farms at Aberdeen, Caldwell, Sandpoint, Tetonia, and Parma, and in cooperative tests with farmers in every agricultural county in Idaho.

In the report which follows, the 12 departments of the Experiment Station review the results of agricultural research conducted by them in 1940. These results have much to contribute to better farming and homemaking. Nearly all of the many research projects have been undertaken at the request of Idaho farmers through the Extension Service or through farmer organizations. This bulletin is a progress report to the farmers of Idaho of the results of the investigations of the past year.

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Introduction

WHEN Idaho was admitted to the Union, someone said that the new state was composed of 84,000 square miles and inhabited by 84,000 square men. Although there are more people in Idaho now than there were then, the population is still relatively small in comparison to the area of the State.

The total cultivated land comprises only 8 per cent of the total area and irrigated farms comprise only 4 per cent of the total. Seventy-four and three tenths per cent of the 53,346,560 acres in Idaho is publicly owned. These and other facts contribute to a condition which makes the farming business in Idaho a complex one. Perhaps in no other state have problems of production, marketing, and land-use adjustment been more in need of careful investigation than here.

The outcome of the war overseas will have a profound influence upon agriculture. New problems will arise and adjustments will be necessary. Your Experiment Station will be called upon to lead the way.

Elsewhere in this bulletin will be found a detailed list of projects being investigated by the 12 departments of the Experiment Station. There are over 120 of these projects and they cover nearly every type of problem encountered in farming and homemaking.

In the following pages will be found reports of the departments of the Main Station at Moscow and the Branch Stations located in various parts of the State.

Cooperative Relationships Varied

MUCH of the research of the Idaho Agricultural Experiment Station is conducted in cooperation with various bureaus of the United States Department of Agriculture, the various state agricultural experiment stations, and other public and private agencies.

A list is given below of the formal cooperative projects conducted with various agencies:

Bureau of Plant Industry:

Division of Cereal Crops and Diseases—Relative to the control of noxious weeds, particularly the European bindweed *(Convolvulus arvensis)*.—Small grain investigations.—Forage crop investigations.

Division of Fruits and Vegetable Crops and Diseases—Investigations on potato breeding and culture.

Division of Soil Survey—Survey of Idaho soils.

The Division of Cereal Crops and Diseases and the Office of Forage Crops and Diseases have additional extensive cooperative research at the Aberdeen Branch Station.

Bureau of Animal Industry:

Animal Husbandry Division—Long distance transfer of semen for the artificial insemination of sheep.

Bureau of Dairy Industry:

Division of Dairy Herd Improvement—Continuous use of proved sires to breed dairy cattle that will be pure in their inheritance for high milk and butterfat producing capacities.

Bureau of Agricultural Economics:

Division of Conservation and Land-Use Adjustment—Agricultural land-use planning and research relating thereto.—An economic and sociological investigation of problems in connection with recent land settlement on the cut-over lands of northern Idaho.

Bureau of Agricultural Chemistry and Engineering:

Division of Agricultural Engineering—Irrigation investigations and research.—Cost, effectiveness, and methods of pumping for drainage and supplementary irrigation.

Fruit and Vegetable By-Products Laboratory—Investigation of new products and by-products from fruits and vegetables.

Bureau of Entomology and Plant Quarantine:

Truck and Garden Insects Division—Truck crop insects, including sugar beet leafhopper and curly top, factors of populations and migrations.—Wireworms: experiments in control.—Pea weevil investigations.

Soil Conservation Service:

Division of Research—Irrigation investigations in the State of Idaho during the fiscal year 1940.—Soil and water losses under controlled conditions as influenced by the application of organic materials to the soil (Project agreement under above).—Soil and water conservation and hydrologic investigations in the State of Idaho (Project agreement under the overall memorandum).

Miscellaneous:

Western Range Survey within "WRS" Region E (Montana, North Idaho, and northeastern Washington), in cooperation with the Agricultural Adjustment Administration, United States Forest Service, Soil Conservation Service, the Division of Grazing, the Bureau of Indian Affairs of the Department of Interior, and the Washington and Montana Agricultural Experiment Stations.

Western Cooperative Spray Project, in cooperation with the Bureau of Entomology and Plant Quarantine, Bureau of Plant Industry of the U. S. Department of Agriculture and the Agricultural Experiment Stations in the northwestern states and the province of British Columbia.

Investigations in the control of the beet leafhopper and the breeding of curly top resistant beans are conducted at Twin Falls, Idaho, in cooperation with the Beet Leafhopper Control Fund Administration of the State of Idaho, the Bureau of Entomology and Plant Quarantine, and the Bureau of Plant Industry of the U. S. Department of Agriculture.

The Department of Agricultural Engineering of the Idaho Agricultural Experiment Station has cooperated for a number of years with the Idaho Committee on the relation of electricity to agriculture.

In cooperation with Home Economics Departments of the states of Oregon, Washington, Montana, and Utah, the Home Economist of the Idaho Agricultural Experiment Station is studying the ascorbic acid metabolism of college students.

The Idaho Agricultural Experiment Station cooperates with the 12 western range states and with the U. S. Department of Agriculture in the program of the Bankhead-Jones Laboratory for the improvement of sheep through breeding at Dubois, Idaho. Problems relative to the salinity of irrigation water and of soil conditions to plant growth and related factors involved in a permanently successful irrigated agriculture are studied cooperatively at the Bankhead-Jones Laboratory at Riverside, California. This research program is conducted by the U. S. Department of Agriculture in cooperation with the 11 western states and Hawaii.

The Idaho Agricultural Experiment Station cooperates with the other 11 western states and the U. S. Department of Agriculture in the work of the Western Regional Laboratory for the utilization of farm products at Albany, California.

The Idaho Advertising Commission has assisted in financing the investigation of the use of potatoes for the production of industrial alcohol at the laboratory at Idaho Falls, Idaho.

The Union Pacific Railroad Company is sponsoring a 2-year graduate fellowship for the study of bacterial ring rot of potatoes in Idaho.

The American Potash Institute, Inc., is helping to finance the study of alfalfa yellows and drought spot of apples which is caused by deficiency of available boron in the soil.

The Crites Moscow Growers, Inc., have contributed funds for the study of seed pea diseases in Idaho.

Active Experiment Station Projects

Agricultural Chemistry

Ag.Chem. P-2	A Study of Certain Types of Chlorosis as Found in Idaho on Trees, Shrubs, and Herbaceous Plants. (In cooperation with Agronomy, Agricultural Engineering, Plant Pathology, and Horticulture.)
Ag.Chem. P-5	A Study of the Availability of Plant Nutrients and the Response to Fertilizers of Idaho Soils. (In cooperation with Bacteriology and Agronomy.)
Ag.Chem. P-6	A Study of the Vitamin A Requirements of Poultry and the Efficiency of the Precursal Sources of Vitamin A in Plant Forage for Meeting these Nutritive Requirements. (In cooperation with Poultry Husbandry.)
Ag.Chem. P-7	The Utilization by Fermentation Processes of Idaho Farm Products. (In cooperation with Agricultural Engineering.)
Ag.Chem. A-2	The Relation of the Yield and Protein Content of Wheat to Nitrogen Content of the Soil Under Different Systems of Cropping. (In cooperation with Agronomy.)
Ag.Chem. A-9	The Influence of Irrigation Practice Upon the Physical and Chemical Properties of Soil, with Particular Reference to Salinity. (In cooperation with Agronomy.)
Ag.Chem. A-10	The Properties and Interreactions of Organic and Inorganic Colloids in Idaho Soils.
Ag.Chem. H-11	The Feeding Value of Distillers' By-Products.

Agricultural Economics

Ag.Econ. P-23	The Relation of Tenancy and Ownership to Farm Crop Enterprises by Types of Farming Areas of Idaho.
Ag.Econ. P-25	Economic Status of the Dry-Land Farmers of Eastern Washington County.
Ag.Econ. P-27A	Economic Situation in the Mann Creek Farming Area of Washington County and Feasibility of a Reservoir for a Supplementary Water Supply.
Ag.Econ. P-28	Economic Status of the Dry-Land Farmers of Teton River Drainage in Teton, Madison, and Fremont Counties.
Ag.Econ. P-29	Planning for the Settlement of the Black Canyon Extension Irrigation Project in Canyon, Payette, and Gem Counties.
Ag.Econ. P-30	Economic Status of the Dry-Land Farmers of Western Oneida County.
Ag.Econ. P-30A	A Study of the Factors Influencing the Market Value of Real Estate in Latah, Nez Perce, and Lewis Counties.

Agricultural Engineering

Ag.Engr. P-31	A Study of Methods, Equipment, Organization, Effectiveness, and Cost of Tillage Operations in Summer Fallow and Seedbed Preparation on Farms in Idaho.
Ag.Engr. P-32	A Study of Methods, Equipment, Crew Organization, and Cost of Harvesting and Stacking Hay in Southern Idaho.
Ag.Engr. P-33	A Study of the Adaptation of the Combine to the Harvesting of Field Peas and Beans.
Ag.Engr. P-34	The Preparation and Maintenance of Farm Lands for Irrigation as Affected by the Use of Farm Machinery.
Ag.Engr. P-35	Effect of Movement and Distribution of Irrigation Water on Field Crops. (In cooperation with Agronomy.)
Ag.Engr. P-36	Canal Linings.
Ag.Engr. P-37	A Study of the Cost, Effectiveness, and Methods of Pumping for Drainage and Supplemental Irrigation.
Ag.Engr. P-38	The Development of a Method for Structurally Testing Farm Buildings.
Ag.Engr. P-39	A Study of Ventilation and Lighting of Dairy Barns. (In cooperation with Dairy Husbandry.)
Ag.Engr. P-40	A Study of the Production and Use of Petroleum Alcohol Blends as a Fuel for Internal Combustion Engines. (In cooperation with Agricultural Chemistry.)
Ag.Engr. P-41	Potato Production Structures and Equipment. a. Structural and functional design of potato storages under Idaho conditions. b. The design and function of mechanical equipment in the handling, sorting, grading, washing, sizing, packaging, and shipping of potatoes. c. Field power and machinery for the mechanization of potato production (planting, cultivating, harvesting, transport).
Ag.Engr. P-42	Farm Refrigeration Requirements.
Ag.Engr. P-43	Stabilized Soil Mixtures for Farm Roads and Walks for Footings, Floors, and Foundations for Farm Buildings.

Agronomy

Agron. P-46	Forage Crops Seed Production.
Agron. B-J 2	The Control of Noxious Weeds, Particularly European Bindweed *(Convolvulus arvensis)*.
Agron. H-8	Breeding of Silage Crops.

Agron. H-9	Cereal Breeding.
Agron. H-10	Changes in the Physical Properties of Soils Under Different Management Practices.
Agron. S-25	Clover and Alfalfa Breeding.
Agron. S-26	Improvement of Grasses.
Agron. S-27	Pea Breeding and Morphological Studies.
Agron. S-28	Sweet and Field Corn Investigations.
Agron. S-29	Varietal and Genetic Studies of Field Beans. (In cooperation with Aberdeen Branch Station.)
Agron. S-30	Crop Rotation Studies.
Agron. S-31	Fertilizer and Soil Amendment Studies.

Animal Husbandry

A.H. P-51	Steer Feeding Investigations. The Influence of Phosphorous in Rations for Fattening Cattle. (In cooperation with Caldwell Branch Station and Agricultural Chemistry.)
A.H. P-52	Lamb Feeding Investigations. The influence of Phosphorous in Rations for Fattening Lambs. (In cooperation with Caldwell Branch Station and Agricultural Chemistry.)
A.H. P-53	A Study of the Cause and Methods of Control of Foul Sheath or Sheath Necrosis in Bucks. (In cooperation with Bacteriology.)
A.H. P-54	A Study of the Life Cycle and Methods of Control of *Oestrus ovis* (Grub in the Heads) of Sheep.
A.H. P-55	The Biological Value of the Protein of Field Peas and the Effect of Heat Treatment on Pea Protein. (In cooperation with Home Economics and Agricultural Chemistry.)
A.H. P-57	Swine Progeny Testing and Improvement.
A.H. B-J 3	Composition of Range Forage as Related to Animal Nutrition. (In cooperation with Agricultural Chemistry.)
A.H. B-J 4	The Phosphorous Requirements of Sheep and Beef Cattle. (In cooperation with Agricultural Chemistry.)
A.H. B-J 5	A Study of the Etiology and Control Methods of Chronic Swine Erysipelas as it Exists in Idaho.
A.H. S-1	Lamb Feeding Investigations: To Determine the Value of Wet Beet Pulp, Beet Top Silage and Corn Silage. (In cooperation with Caldwell Branch Station.)
A.H. S-2	Steer Feeding Investigations: To Determine the Value of Wet Beet Pulp, Beet Top Silage and Corn Silage. (In cooperation with Caldwell Branch Station.)
A.H. S-3	Wintering Calves That are to be Grazed (Irrigated Pasture) Following Season and Fattened for Early Winter Market. (In cooperation with Caldwell Branch Station.)
A.H. S-4	Feeding and Management of Ewes, and Creep Feeding of Lambs for Early Lamb Production. (In cooperation with Aberdeen Branch Station.)
A.H. S-6	A Study of Methods of Collecting Semen from Rams in Relation to Quality of Semen.
A.H. S-8	Variations in the Carotene Content of Beef Fat. (In cooperation with Caldwell Branch Station and Agricultural Chemistry.)
A.H. S-9	Nutritive Value of Michel's Grass Seed.
A.H. S-39	Urinary Calculi in Sheep. (In cooperation with Agricultural Chemistry.)

Bacteriology

Bact. A-3	Coniferous Timber Soil Investigations. Subproject III. Factors influencing Reclamation and Reforestation of Forest Soils. (In cooperation with Agricultural Chemistry.)
Bact. A-7	An Investigation of the Etiology of Infectious Bovine Mastitis. (In cooperation with Animal Husbandry and Dairy Husbandry.)
Bact. B-J 6	Bacteriological Factors Affecting the Growth of the Alfalfa Plant.

Dairy Husbandry

D.H. P-81	Influence of the Kind of Crop Used and the System of Management and Value of Pastures for Dairy Cattle. (In cooperation with Caldwell Branch Station, Agricultural Chemistry and Home Economics.)
D.H. P-82	A Study of the Use of Phenylmercuric Nitrate and Other Chemicals in the Treatment of Mastitis in Cattle. (In cooperation with Animal Husbandry and Bacteriology.)
D.H. P-83	Influence of Vitamin E on Sterility in Dairy Cattle. (In cooperation with Animal Husbandry.)
D.H. P-84	Study of the Vitamin E Content of Pea Germ Meal. (In cooperation with Home Economics.)
D.H. P-85	Artificial Insemination of Dairy Cattle. (In cooperation with Animal Husbandry.)
D.H. P-86	The Deficiencies of Alfalfa Hay as a Sole Diet for Herbivora.
D.H. H-1	Continuous Use of Proved Sires to Breed Dairy Cattle That Will be Pure in Their Inheritance for High Milk and Butterfat Producing Capacities.
D.H. H-2	Study of Breeding Efficiency in Dairy Herds.
D.H. H-3	A Study of Solids-Not-Fat Content of Milk of the University of Idaho Jersey and Holstein Herds.
D.H. S-10	Official Testing for Advanced Registry or Register of Merit in the State of Idaho.
D.H. S-11	Investigation in the Use of Dairy Sires from Ancestors of Known Production with Cooperative Bull Associations and Dairy Bull Studs.
D.H. S-12	Vitamin A and Carotene Content of Idaho Butter. (In cooperation with Agricultural Chemistry and Home Economics.)
D.H. S-13	The Influence of Temperature on the Keeping Quality of Cream.
D.H. S-14	Minimum Protective Dose of Vitamin A for the Lactating Cow.
D.H. S-32	Improvement of Milk Supply for Idaho Creameries and Cheese Factories.
D.H. S-33	The Influence of Homogenization of Milk or Cream on the Ripening of Cheddar Cheese. (In cooperation with Agricultural Chemistry.)
D.H. S-34	A Comparison of Suggested Methods of Determining the Fat Content of Whey.
D.H. S-35	Effect of Preliminary and Non-Preliminary Milkings on the Monthly Fat Production of Dairy Cattle.
D.H. S-36	The Relative Accuracy of Two Methods of Calculating the Monthly Milk Fat Production.

Entomology

Ent. P-92	Experiments in Control of Wireworms on Irrigated Land and Study of Economic Species. (In cooperation with Bureau of Entomology and Plant Quarantine, U.S.D.A.)
Ent. P-93	Pea Weevil: Ecological Study and Investigation in Control. (In cooperation with Agricultural Engineering and Bureau of Entomology and Plant Quarantine, U.S.D.A.)
Ent. P-94	Studies in Insect Physiology and Toxicology. (3 Subprojects).
Ent. P-94a	Studies of the Effect of Various Insecticides in Insect Physiology.
Ent. P-94b	Control of Various Garden, Field, Fruit, and Ornamental Crop Insects by Insecticides Commonly Accepted as Standards in Comparison With Newly Developed Insecticides.
Ent. P-94c	Studies of Various Insecticides in the Control of Hemipterous Insects, (1) Moisture and Insect Relationships in Alfalfa Production. (In cooperation with Aberdeen Branch Station and Agronomy.)

Home Economics

H.Ec. P-101	A Study of the Vitamin G Content of the Idaho Russett Burbank Potato.
H.Ec. P-102	Study of Vitamin A Content of Pasture Plants Under Pasturage Conditions. (In cooperation with Dairy Husbandry.)
H.Ec. P-103	The Ascorbic Acid Metabolism of College Students.

Horticulture

Hort. P-111	Factors Influencing Crotch Angles in Young Fruit Trees.
Hort. P-112	Crops and Cultural Practices for Abandoned Orchard Land.
Hort. P-113	Flower Primordium Development in the Onion in Relation to Seed and Dry Onion Production.
Hort. P-114	Vegetable Seed Production in Idaho.
Hort. P-115	Germination, Stand, and Yield of Potatoes Planted at Different Dates as Affected by Temperatures and Methods of Handling Immediately Prior to Planting. (In cooperation with Aberdeen Branch Station.)
Hort. P-116	Killing Potato Vines to Hasten Tuber Maturity.
Hort. A-1	Apple Breeding.
Hort. A-8	Factors Influencing the Cracking of Sweet Cherries.
Hort. H-4	Potato Production Problems.
Hort. H-5	Variety Testing of Fruits and Vegetables.
Hort. S-15	Orchard Fertilization and Cover Crops. (In cooperation with Agronomy.)
Hort. S-16	Horticultural By-Products. (In cooperation with U. S. Department of Agriculture.)
Hort. S-38	Onion Seed Production.

Plant Pathology

Pl.Path. P-121	Bean Disease Investigations in Idaho.
Pl.Path. P-122	Investigations of Two Important Legume Diseases in Idaho: Stem Rot of Legumes, *Sclerotinia trifoliorum* Eriks., and Black Stem of Alfalfa, *Phoma medicaginis* Malbr. and Roum.
Pl.Path. P-123	Investigation of Pea Diseases in Idaho.
Pl.Path. P-124	Relation of Mineral Nutrition to the Reaction of Various Hosts to Infection by Plant Pathogens.

Pl.Path. P-125	Control of Storage Diseases of Carrots.
Pl.Path. A-4	Virus Diseases of Potatoes.
Pl.Path. B-J 1	Certain Diseases of Stone Fruits.
Pl.Path. B-J 7	Bacterial Ring Rot of Potatoes.
Pl.Path. H-6	Investigation of Fire Blight of Pears.
Pl.Path. H-7	Boron Deficiency Studies. (In cooperation with Agronomy and Agricultural Chemistry.)
Pl.Path. S-17	Gooseberry Mildew Control.
Pl.Path. S-18	Plant Disease Survey.
Pl.Path. S-19	Curly Top of Tomatoes.
Pl.Path. S-20	Diseases of Ornamentals.
Pl.Path. S-21	Cereal Disease Investigations. (In cooperation with U. S. Department of Agriculture.)
Pl.Path. S-37	Bramble Diseases.

Poultry Husbandry

P.H. P-132	Biological and Immunological Studies on Poultry Diseases. (In cooperation with Bacteriology and Animal Husbandry.)
P.H. P-133	Feather Development as Influenced by the Diet. (In cooperation with Agricultural Chemistry.)
P.H. S-22	Study of Mortality in the Experiment Station Laying Flock. (In cooperation with Animal Husbandry.)
P.H. S-23	A Study of Grasses in Relation to Their Manganese Content as a Corrective Factor in Preventing Perosis in Growing Chicks. (In cooperation with Agricultural Chemistry and Home Economics.)
P.H. S-24	To Compare the Efficiency of White Grain Rations With and Without Carotene or Other Carotenoid Pigments Which are Supplied by Alfalfa Meal, when the Basal Mash Contains Cod Liver Oil Concentrate (3000 A, 400 D) at the Rate of 0.5 Per Cent of Mash.

NOTE: The letters used with numbers in identifying projects refer to funds used as follows:

P—Purnell
A—Adams
H—Hatch
B-J—Bankhead-Jones
S—State and Local Funds

Beef Cattle, Horses, Sheep, and Swine

Nutritional Limitations of Beet By-Product Rations for Yearling Steers

YEARLING steers fed a daily basal ration of beet molasses, 4.0 pounds; alfalfa hay 9.0 (limited amount); and all the wet beet pulp they would eat (48 to 63 pounds) were found to be deficient in phosphorus but adequately supplied with protein *(Table 1)*. These conclusions are based on the following evidence:

1. A definite phosphorus deficiency was produced when yearling steers were fed on a daily basal ration of beet molasses, 4 pounds; wet beet pulp, 48 pounds; and alfalfa hay, 9 pounds. Symptoms of phosphorus deficiency in the steers was manifested by low blood

phosphorus, slow gains, poor finish, decreased consumption of wet beet pulp, and the eating of boards and dirt. It required only 17 days to show signs of a lack of phosphorus due to the dry range condition last fall. In previous years it has required about 60 days.

2. The feeding of 0.1 pound of bonemeal daily to each steer (Lot 2) on the basal ration increased the average daily gain from 0.76 to 1.53 pounds and caused a 46 per cent reduction in the feed required per 100 pounds of gain.

3. In Lot 3, bloodmeal was added to the basal ration to determine if it was low in protein. Bloodmeal was used because it is the only protein supplement that does not add an appreciable amount of phosphorus. The steers in Lot 3 became phosphorus deficient and showed essentially the same symptoms as the steers in Lot 1. Slightly faster gains were made because of the small amount of phosphorus furnished by the bloodmeal. The extra protein did not increase the gains, as shown in Lot 4.

4. A comparison of Lots 2 and 4 indicates that the nutritional deficiency in the basal ration was phosphorus and not protein. Supplementing the ration with bloodmeal did not increase the gains or efficiency of feed utilization when the phosphorus was met.

5. These data indicate that cottonseed meal fed at the rate of 1 pound per steer daily may serve as effective a source of phosphorus as bonemeal (Lot 5).

Table 1.—Nutritional limitations of a ration of beet molasses, wet beet pulp, and alfalfa hay for yearling steers.

Lot No.	Daily ration	Av. daily gain lb.	Feed per 100 lb. gain			Daily phosphorus intake gm.	Blood phosphorus minimum level mg/100 ml.
			Concentrate lb.	Hay lb.	Pulp lb.		
1	Basal ration	0.76	510	1238	6281	7.92	2.3
2	Basal ration + 0.1 lb. bonemeal	1.53	260	600	4147	14.91	5.1
3	Basal ration + 0.5 lb. bloodmeal	1.04	425	882	4683	8.03	2.6
4	Basal ration + 0.1 lb. bonemeal + 0.5 lb. bloodmeal	1.52	294	597	4010	15.04	5.4
5	Basal ration + 1.0 lb. cottonseed meal	1.53	318	593	3830	14.08	4.5
6	Basal ration + 4.0 lb. barley instead of molasses	1.48	262	656	3813	13.87	5.0

6. The substituting of barley for beet molasses in Lot 6 indicated that barley fed at the rate of 4 pounds per steer daily in a ration of this type will supply enough phosphorus for normal growth and fattening. A comparison of Lots 2 and 4 shows that beet molasses fed at the rate of 4 pounds per steer daily was equal to barley as a fattening feed, when bonemeal was added to the molasses ration.

7. The amount of phosphorus fed in Lots 2, 4, 5 and 6 ranging from 14 to 15 grams per steer daily is the minimum level of phosphorus that steers of this weight should receive. A slight reduction in the phosphorus intake caused a temporary deficiency in these

steers; therefore, even slightly larger amounts of phosphorus would be advisable. *(W. M. Beeson, C. W. Hickman, D. W. Bolin, R. F. Johnson, E. F. Rinehart.)*

How Much Phosphorus Do Lambs Need?

Further studies on the phosphorus requirement for fattening lambs has revealed more quantitative data by feeding lambs a constant phosphorus intake per unit of liveweight. Lambs receiving 1.23, 1.26, 1.28, 1.50, 1.61, and 1.62 grams of phosphorus per 100 pounds of liveweight all showed definite signs of a phosphorus deficiency. A lack of this mineral element in the diet was manifested by slow gains, inefficient feed utilization, lack of finish, listless appearance, narrow and leggy conformation, gnawing of fences, and eating dirt. All the lambs in the deficient lots had a low blood phosphorus level ranging from 2.5 to 3.6 mg. per 100 ml. of blood plasma. Five mg. of phosphorus or above per 100 ml. of blood is normal.

Ample phosphorus was provided by the feeding of 1.85 to 2.26 grams of phosphorus per 100 pounds of liveweight or 1.41 to 1.71 grams of phosphorus per head daily during the fattening period. The lower level appears to be the minimum level for fattening lambs.

Due to the dry range conditions the lambs responded more readily to the low phosphorus rations than previously and became phosphorus deficient within the first week of the experiment. However, in the three previous years, it has required about 60 days to deplete lambs to a phosphorus-low condition. This brings out the fact that unfavorable range conditions tend to make stock more susceptible to nutritional deficiencies because the body stores of these elements have been depleted.

Converting the above results to a practical feed basis, these data show that the phosphorus requirement of lambs may be satisfied by the proper use of farm-grown feeds, such as grain and alfalfa hay. Therefore, the phosphorus needs of lambs may be met by feeding the following amounts of any of the feeds per lamb daily: 2.0 pounds of alfalfa hay, 2.0 pounds of clover hay, 1.0 pound of barley, 1.0 pound of wheat, 1.0 pound of oats, 0.33 pound of wheat bran, or 0.03 pound of steam bonemeal.

Beet pulp and beet molasses are deficient in phosphorus, but lambs receiving about 2 pounds of alfalfa hay or 0.5 pounds of grain plus 1.0 pound of alfalfa hay per head daily, as a supplement to pulp and molasses, will receive ample phosphorus. Since the majority of lamb fattening rations in Idaho contain large quantities of good quality alfalfa hay, along with barley, there is little danger of a lack of phosphorus. *(W. M. Beeson, C. W. Hickman, D. W. Bolin, R. F. Johnson, E. F. Rinehart.)*

Blood Phosphorus Levels of Range Ewes Vary with the Season

For the past 3 years a study has been made on the variation in the blood phosphorus level of range ewes. Table 2 gives a summary

Figure 1.—Blood phosphorus studies are being made on range ewes at the U. S. Sheep Experiment Station, Dubois, Ida.

of the results obtained at different seasons of the year from about 42 head of Columbia ewes which were handled under range conditions at the U. S. Sheep Experiment Station, Dubois, Idaho *(See Figure 1)*.

In the fall of 1938, only 24 per cent of the ewes indicated low blood phosphorus levels, while in 1939, 74 per cent of the ewes were deficient. This reveals the effect of a dry grazing season on phosphorous intake. In the summer and fall of 1939, feed matured fast due to low rainfall and consequently was low in phosphorous. This corroborates our previous work with range forage, in which it has been shown that most palatable forages are deficient in phosphorous during the fall and winter months. Furthermore, it was observed that the sheep ate less browse in 1939 than in 1938, which may partially explain the higher incidence of low phosphorous blood levels among the ewes in 1939. Browse contains a larger percentage of phosphorous during the fall and winter grazing season than weeds or grasses. Phosphorous deficiency is more likely to occur during the fall and winter grazing season following a dry summer season because the ewes have not had a chance to build up body stores of phosphorous.

Alfalfa hay was fed for 10 days to the ewes when on the range in the fall of 1939, to determine if the low blood phosphorous levels could be brought back to normal. After 10 days of alfalfa feeding, the percentage of ewes low in blood phosphorous was reduced from 74 to 14 per cent.

From 67 to 77 per cent of the ewes showed low blood phosphorous levels during the winter feeding period of 1940, and only 20 per cent of the ewes showed signs of aphosphorosis under essentially the same feed conditions in the winter of 1939. An analysis of the alfalfa hay fed in 1939 was low in phosphorous, ranging

from 0.11 to 0.17 per cent. A feed containing 0.14 per cent or less phosphorus is deficient. Although hay analyses were not made in 1940, the same type of hay was fed. The higher incidence of aphosphorosis in 1940 was probably due to the lower level of body stores of phosphorus, due to the dry range feed conditions. It also appears from our data, that ewes, during the lambing and suckling period, have a lower blood phosphorus level, due to the extra demands on the ewe for bone and milk production. It may be that a ewe remains in a negative phosphorus balance during the latter part of gestation and at the first part of the lactation period regardless of the phosphorus intake. Even the addition of cottonseed cake to the ration of the ewes failed to reduce the per cent aphosphorosis, which further substantiates the assumption that a low content of phosphorus in the blood may be inevitable at times of high requirement.

Lambing appears to have an effect on blood phosphorus levels. Ewes which had already lambed had an average of 3.26 mg. of phosphorus per 100 ml. of blood plasma, as compared with 4.19 mg. for ewes that had not lambed, with 81 per cent and 69 per cent of the ewes deficient, respectively. Ewes suckling single lambs had an average of 5.69 mg. of phosphorus on June 10, 1940, as compared with 4.64 mg. for ewes suckling twin lambs. Assuming that ewes suckling twin lambs produce more milk, one might conclude that increased milk production results in a lowering of the blood phosphorus level.

This study is being continued and may be enlarged to study the effect of mineral supplements on the number and strength of the lambs, the milking qualities of the ewe, and longevity. *(W. M. Beeson, D. W. Bolin, C. W. Hickman, cooperative with the U. S. Sheep Experiment Station, Dubois, Idaho.)*

Table 2.—Seasonal changes in the blood phosphorus level of range ewes

Date bled	Previous feeding conditions	Variation in the blood phosphorus level of range ewes, mg. per 100 ml. plasma			Total no. of ewes	Ewes phosphorus Deficient, %
		2.0-3.5[1]	3.6-4.5[2]	4.6-7.0[3]		
11-16-38	Fall range (8 weeks)	2	8	32	42	24
1-17-39	Winter range (6 weeks)	0	4	35	39	10
2-28-39	Winter feed lot (6 weeks) alfalfa hay	0	8	31	39	20
11-16-39	On fall range (8 weeks)	8	23	11	42	74
12-14-39	Fall range (3 weeks) alfalfa hay 10 days	1	5	36	42	14
1-18-40	Winter range (4 weeks)	0	0	40	40	0
3-27-40	Winter feed lot (8 weeks) alfalfa hay	2	26	14	42	67
4-19-40	Winter feed lot (3 weeks) alfalfa hay+cottonseed cake	15	14	10	39	74
6-10-40	Spring range (8 weeks)	0	5	29	34	15
9- 3-40	Summer range (11 weeks)	3	14	13	30	57

[1] Severe deficiency
[2] Moderate deficiency
[3] No deficiency

Improvement through Swine Progeny Testing

A project on swine improvement through progeny testing and improved breeding methods has been undertaken at the Idaho Agricultural Experiment Station. Improvement is being sought in the productiveness of sows, growth rate of pigs, economy of gains, physical vigor and quality of carcass. The experimental herd has been set up as a four-sire herd, which is being intensely line bred to a particular outstanding boar. Top crosses of the inbreds and outbreds are to be made to check the results in the inbred line from time to time. The foundation herd at present consists of 20 Poland China sows and 4 Poland China boars. *(D. E. Brady, W. M. Beeson, C. W. Hickman, P. J. Carlson.)*

Lower Evaporation Rate Indicated on Sharp Frozen Meats

Data which have been collected on beef round steak, lamb chops and pork steak indicate that sharp frozen meats dehydrate less when held in cold storage for 6 months than meat which has been slow frozen.

Table 3.—Average per cent evaporation after 6 months storage at –10 degrees F. and at 85 to 90 per cent relative humidity

	Slow frozen	Sharp frozen
Beef	8.9	7.9
Lamb	6.1	5.5
Pork	4.3	3.6

The above table indicates that the evaporation rate was consistently lower on the sharp frozen meats than on the slow frozen meats, and that the beef had the highest rate and pork the lowest. All packages of meat were double wrapped in 30-pound wax paper and regular meat wrapping paper. *(D. E. Brady, C. W. Hickman.)*

Yellow Color in Beef Fat Studied

In cooperation with the Department of Agricultural Chemistry, a study of the carotene content of beef fat has been conducted. Fat from carcasses of cattle showing evidence of Guernsey and Jersey breeding or from cattle which have had access to considerable green feed previous to slaughter has been found high in carotene. Beef carcasses which have approximately 100 micrograms of carotene per 100 ml. of fat are subject to discrimination on the market. Additional work is now in progress to determine the rate of depletion in the fat of grass fed steers when changed to dry lot feeding. *(D. E. Brady, D. W. Bolin, W. M. Beeson.)*

Swine Erysipelas Investigations Continued

Studies on swine erysipelas were continued in cooperation with the Department of Bacteriology during 1940. Animals showing high titers to the agglutination test and enlarged joints were removed from the herd. This practice was planned as one of the possible ways in controlling the subacute or chronic forms of erysipelas. Another method employed in the prevention of this malady was the early administration of hyperimmune erysipelas serum to suckling pigs. Very few pigs developed arthritis during the year. One litter contracted a severe polyarthritis soon after birth. None of these pigs gave a positive reaction to the erysipelas agglutination test. Post mortem and bacteriological studies revealed that this litter developed an omphalitis with the usual spread of infection at the joints. This condition was caused by the bacterium *Staphylococcus aureus*. A few young pigs showed enlargement of joints but their condition proved to be a vitamin D deficiency. They responded to medication with cod liver oil. None of these pigs gave a reaction to the agglutination test.

It cannot be definitely stated at this time that subacute erysipelas can be controlled by drastic culling. It appears, however, that removal of carriers together with other sanitary practices does reduce the incidence to a minimum.

The agglutination test when correlated with clinical symptoms is of value in detecting subacute and chronic erysipelas. Many animals which are apparently free from the disease either in the active or carrier stage, react to the agglutination test in dilutions below 1:200. *(G. C. Holm, W. M. Beeson.)*

Mastitis Control Investigated

Studies on mastitis have continued in cooperation with the Departments of Dairy Husbandry and Bacteriology. Routine use of diathermy as a therapeutic measure has been employed. This treatment was frequently augmented by oral administration of sulphanilamide. Acute new cases appear to be relieved and acute periods in chronically affected animals seem to be reduced in the severity of attack.

Infusion of the udders of chronically affected cows with acriflavine did not appear to control the disease. Further studies on this type of medication will be made, using different types of therapeutic agents. *(G. C. Holm, D. L. Fourt, F. C. Fountaine, W. V. Halversen, V. A. Cherrington.)*

Dairy Production and Manufacturing

Proved Sire Program Maintains Excellent Rating for University Dairy Herd

THE Holstein-Friesian and Jersey herds owned by the University of Idaho each continued on the qualified list for the highest honor awarded by the respective breed associations. The American

Jersey Cattle Club awarded the fourth consecutive Constructive Breeders Registry Certificate to the Jersey herd during the year. The Holstein herd is one of five herds in America which has qualified for two consecutive years for the Progressive Breeders' Registry Certificate awarded by the Holstein-Friesian Association of America. The University of Idaho dairy herd is the only college herd in America where both herds have qualified for these high awards. The qualification is based on combined high achievement in production, type, number of animals bred by owner, and the observance of a satisfactory disease control program. These high standards have been accomplished as a result of the continuous use of proved sires.

The Holstein herd has used 14 proved sires, 11 of which have had daughters and dams tested in the herd. Of the 11 sires, 9 increased production, 1 held production approximately equal, and 1 decreased production. Daughters of three other proved sires are in the herd, some of them on test. The last bull to be proved was the highest transmitting bull ever used in the herd, as 10 daughters with first calf averaged 594 pounds of fat. When the daughter-dam records were adjusted to yearly Mature B basis, the daughters averaged 766.6 pounds of fat, and the dams 703.8 pounds, or an increase of 63 pounds of fat, which is remarkable considering the high production of the dams. These daughters also had an average increase of fat of approximately 0.5 per cent.

Of six proved sires used in the Jersey herd, four have completed daughter-dam records in the herd. Three increased production and one decreased production. Daughters of two other proved sires are in the herd at the present time.

Both herds are accredited as free of tuberculosis and Bang's Disease, and each herd has an average type rating of approximately "Good Plus." During 1940, the average herd production, including dry cows, of the combined Jersey and Holstein-Friesian herds, was 11,175 pounds of milk and 493 pounds of fat. The Holstein herd, composed of 23 cows, had an average production of 14,574 pounds of milk and 512 pounds of fat. The Jersey herd of 18 cows averaged 8,421 pounds of milk and 465 pounds of fat.

The success of the proved sire program is well shown by the progress made through successive crosses of proved sires of the Holstein-Friesian herd from the foundation cows. The following data *(Table 4)* show the trend of average production from the 24 foundation cows through five successive generations of proved sires. All records were yearly Advanced Registry records made by first lactation heifers without selection, milked three times daily, and adjusted to mature basis for comparison.

The University Holstein-Friesian herd contains one of the outstanding females of the Holstein-Friesian breed, Idaho Piebe Jessica, No. 997662 *(Figure 2)*. Idaho Piebe Jessica, or "67," as she is known in the herd, is almost 16 years of age and has produced her fourteenth calf. She has had 10 daughters and 4 sons. Thirty of "67's" descendants are in the University herd today, including 5 daughters, 15 granddaughters, and 10 great granddaugh-

Table 4.—Trend of average production in the Holstein-Friesian herd

	No. of Cows	Lb. of Fat
Foundation cows	24	537.1
F^1 generation	32	642.6
F^2 generation	36	691.0
F^3 generation	36	717.0
F^4 generation	19	695.0
F^5 generation	5	733.0

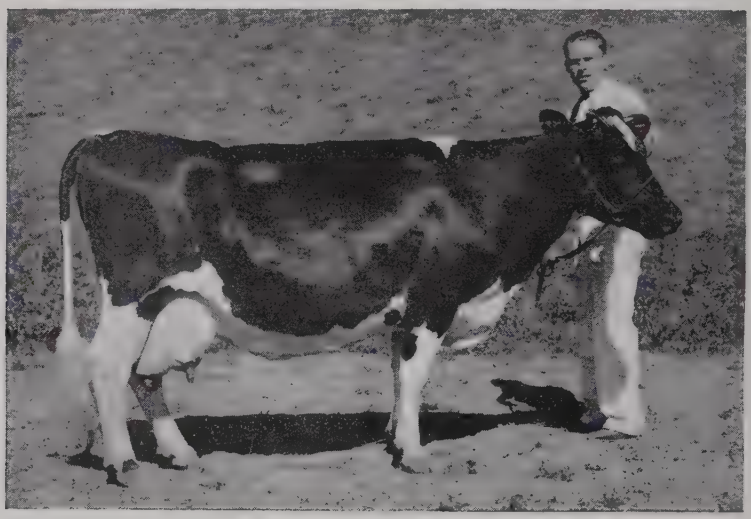

Figure 2.—One of the great cows of the Holstein-Friesian breed, Idaho Piebe Jessica, No. 997662.

ters. Seven of her daughters already have finished test and one more is now on test. The average production of the seven tested daughters is 549 pounds of fat during the first lactation period, in comparison to the 472 pound record of "67" at the same age. This is conclusive proof of the effectiveness of the continuous use of proved sires. While her daughters and granddaughters have contributed so spectacularly to the development of the University herd, her sons and grandsons have been performing with equal effectiveness in the development of Holstein herds throughout Idaho. Four sons and 18 grandsons born in the herd have been, or are, herd sires in the herds of Idaho breeders. "67," during her best year, produced 912 pounds of fat and, to date, has produced approximately 195,000 pounds of milk and over 6,000 pounds of butterfat. *(D. L. Fourt, F. C. Fountaine.)*

Shortwave Diathermy Plus Sulfanilamide Successfully Controls Acute Mastitis

In cooperation with the Departments of Animal Husbandry and Bacteriology, a study was made of the combination of two daily shortwave diathermy treatments of 30 minutes each plus the administration of sulfanilamide at the rate of 5 grams per 100 pounds body weight daily. Nine acute cases responded to the treatment and returned to normalcy in appearance of milk and texture of udder, and remained so during the entire lactation period. Five other acute cases recovered normalcy in appearance of milk, but each had a slightly weak quarter. In the treatment of four chronic cases of mastitis, two cows lost quarters and two later had relapses or new infection during the lactation period. In the chronic cases long chain streptococci were found in the milk throughout the entire lactation period.

Other methods of treatment for the control of mastitis, which were investigated but failed to show satisfactory results, were x-ray, sulfanilamide plus lactovaccine, sulfanilamide plus acriflavine, azomine, merphenylgluconate, and acriflavine.

Improperly sterilized milking machines are believed to be a contributing factor in the spread of mastitis. A detailed study showed that it was necessary to hold the teat cups in a chlorine solution of 100 parts per million of available chlorine for at least 2 minutes in order to assure the destruction of long chain streptococci. *(D. L. Fourt, F. C. Fountaine, G. C. Holm, W. V. Halversen, V. A. Cherrington.)*

Ketosis of Dairy Cattle Studied

The incidence of occurrence of ketosis was studied over a period of 6 months in a group of 36 Holstein-Friesian and Jersey milking cows. Urine from these cows was drawn at weekly intervals and analyzed qualitatively for the presence of acetone bodies by a modification of Rothera's nitroprusside and ammonium sulphate method.

In this group of cows, receiving a well balanced ration, as high as 66 per cent showed ketosis at some time during the study. An average of 38.7 per cent for the entire period of 6 months showed a reaction to the test.

The disease was found to occur in cows of all ages, but cows in their first lactation showed a larger percentage of cases than mature cows. The disease occurred more frequently in the winter months; after the cows were turned on pasture, they usually were negative to the test.

It was found that molasses, if fed at the proper time and in sufficient amounts, was both prophylactic and therapeutic for the disease. *(F. C. Fountaine.)*

Rapid Field Phosphatase Test Accurate

A comparison of Scharer's improved rapid field test and Kay and Graham's phosphatase test was made on laboratory and commercial pasteurized milk.

Comparatively little difference in accuracy could be detected in the methods used. Scharer's improved rapid field test was more rapid and less expensive than the Kay and Graham phosphatase test. *(F. C. Fountaine.)*

Dairy Stud Bull Associations Showing Excellent Results

The need of the small dairy herd for the use of purebred dairy bulls has been met successfully in many communities in Idaho by the formation of Dairy Stud Bull Associations. At present, there are 21 Dairy Stud Bull Associations, owning 96 bulls and servicing 7,228 cows, operating in the state. A standard form of agreement for the purchase and management of the bulls is used in all associations. The bulls are owned by individuals and cooperative associations have been formed by cow owners to purchase the services of the bulls. The bulls are transported to the various farms when needed.

Available data show that the bulls bred on an average 124 cows per year with 73.7 per cent conception for the first service. *(Ivan H. Loughary.)*

Accuracy of Suggested Methods for the Fat Analysis of Whey Investigated

A comparison was made of the following tests which have been used for the fat analysis of whey: Mojonnier, Babcock, Minnesota, American Association, Acetic Acid, Illinois Nonacid, Nebraska, Penn. State.

Using the Mojonnier method as a standard of comparison, none of the other methods gave a test as high as that obtained for the Mojonnier. However, three tests, the Penn. State, Acetic Acid, and Babcock, were comparatively easy to run and gave fairly satisfactory results. *(H. C. Hansen.)*

Sodium Chloride as a Preservative for Cream Causes Formation of Hydrochloric Acid Gas in the Babcock Test

The use of 5 and 10 per cent concentrations of sodium chloride for the preservation of cream has been advocated by some creameries and is being practiced in certain sections of Idaho. The presence of sodium chloride in the cream has caused considerable trouble in the testing laboratory when making the Babcock test for fat.

In cooperation with the Department of Agricultural Chemistry, it was determined that when making the Babcock test for fat on cream containing 5 or 10 per cent concentrations of sodium chloride, the sulphuric acid releases hydrochloric acid gas in sufficient concentration to be dangerous to the tester, if proper ventilation is not provided in the test room. *(H. C. Hansen, R. S. Snyder.)*

Standardizing Milk with Homogenized Cream Increases Cream Layer Depth

A study was made of the influence of standardizing 3 per cent milk to 3.5, 4.0, and 4.5 per cent, respectively, with both homogenized cream and unhomogenized cream. When the milk was standardized to 3.5 per cent, the homogenized cream increased the depth of the cream layer on an average of 3.12 per cent of the total volume of the milk; when standardized to 4 per cent, the increase was 3.52 per cent; and when standardized to 4.5 per cent, the increase was 3.47 per cent.

A comparison was also made by standardizing 3.5 per cent milk to 4.0, 4.5, and 5.0 per cent, respectively. The influence of the homogenized cream on the depth of the cream layer, when standardizing 3.5 per cent milk, was a little less than when using 3.0 per cent milk.

On an average, results indicated that the use of homogenized cream for standardizing milk causes an appreciable increase in the cream layer volume. The increase ranged from 2.0 to 3.5 per cent of the total volume of the milk. *(D. R. Theophilus.)*

Quality Improvement Work Demonstrates Value and Need

A summary of five summers' quality improvement work in cooperation with the Bureau of Dairying, Idaho State Department of Agriculture, and various creameries in Idaho, presented in Table 5, shows the general quality of milk delivered to the creameries, and indicates the need for a continued emphasis on quality. During the five summers, 14,418 samples of milk were examined for quality by the sediment and methylene blue reduction or Resazurin tests.

Table 5.—Quality of milk received at representative Idaho Creameries

Year	Per cent of patrons producing milk graded as				Total number of patrons
	Grade 1	Grade 2	Grade 3	Grade 4	
1936	8.9	30.6	28.5	32.0	1461
1937	3.9	29.6	42.8	23.7	3128
1938	12.1	39.9	24.8	23.2	3427
1939	28.7	27.8	26.8	16.7	3298
1940	8.4	37.4	33.0	21.2	3104

(H. C. Hansen.)

Homogenization of Milk Decreases the Quality of Cheddar Cheese

A series of trials were made comparing cheddar cheese made from raw milk, homogenized milk, pasteurized homogenized milk, and raw and pasteurized milk standardized with various proportions of homogenized cream. Tentative results indicate that the highest quality cheddar cheese was made from the raw milk; and

although a satisfactory quality cheese was made from the pasteurized homogenized milk, none of the other milk in which homogenization was resorted to produced a satisfactory cheese.

The typical off-flavor found in the cheese from the homogenized milk was "rancid." Further work has been inaugurated to determine the cause of the rancidity and methods of controlling the defect. *(H. C. Hansen, R. S. Snyder.)*

Service Work

During the year, representatives of the Department of Dairy Husbandry spent the following number of days in the field supervising official tests:

Guernsey Advanced Registry	56.5
Guernsey Herd Improvement Registry	31.0
Jersey Register of Merit	18.0
Jersey Herd Improvement Registry	42.0
Holstein Advanced Registry	36.0
Holstein Herd Improvement Registry	94.5

This is a total of 278 days, or 87 days more than the previous year.

The Calibration Laboratory received 6,900 pieces of glassware, which were checked for accuracy. Of these, 6,806 were etched "S. G. I.," leaving only 1.36 per cent which were found inaccurate.

During the past year, 83 analyses of dairy products were made. *(F. C. Fountaine, H. C. Hansen.)*

Poultry

Studies on Carotene Requirements of Laying Hens Concluded

DATA obtained with White Leghorn hens during their third laying year concludes the investigation and confirms previous results on the efficiency of carotene in meeting the vitamin A requirements of laying hens. Results obtained during the first and second laying years of these birds were reported in Idaho Agricultural Experiment Station Bulletins Nos. 229 and 236. It was reported that 0.2 mgs. of carotene per bird daily, (approximately 333 U.S.P. units of vitamin A) as supplied by dehydrated alfalfa, was as satisfactory as higher levels.

This series was started in the fall of 1937, with three duplicate lots and one single lot of 30 single comb White Leghorn pullets each. Dehydrated alfalfa of known carotene content, which had previously been held in cold storage, was added to the mash daily to provide the desired carotene intake. Lots 1, 2, and 3 in duplicate were fed 0.2, 0.3, and 0.4 mgs. of carotene respectively per bird daily. The fourth lot received 0.5 mgs. of carotene.

At the end of the first laying year, 33 birds, representative of the higher producers, were continued on the first two levels. All the

birds on the 0.5 mg. carotene level, plus a sufficient number from the 0.4 level to make a total of 33 birds, were continued on for the duration of the project.

Because of the influence of vitamin A on the general health of the birds, it was thought that if the low level was marginal, it should become apparent throughout a prolonged period. The results obtained during the third year, as measured by egg production, body weight, absence of specific lesions, and hatchability of eggs, again proved the 0.2 mg. daily intake to be adequate. These results and those of the two previous years are briefly summarized in Table 6.

Table 6.—Three-year summary on carotene requirements of laying hens

	1st year				2d year			3d year		
Mg. carotene per bird daily....	0.2	0.3	0.4	0.5	0.2	0.3	0.5	0.2	0.3	0.5
No. birds at start	60	60	60	30	33	33	33	30	26	25
% egg production	47.3	47.2	44.3	54.0	42.8	38.5	41.9	31.6	30.0	33.0
% mortality[1]	18.0	10.0	13.0	23.0	9.0	21.2	24.2	43.0	38.0	60.0
% fertile eggs hatched	82.4	83.0	82.1	81.9	73.9	76.7	70.6	79.6	81.1	84.9

[1] Mortality due to causes other than vitamin A deficiency

The group receiving the 0.2 mg. daily intake throughout the 3-year period is shown in Figure 3. It is evident that these birds were still in good health when the project was terminated. In the periodic examination of live birds and the post-mortem examinations of those that died, no specific vitamin A deficiency lesions were found.

Figure 3.—The group of hens as they appeared at the end of the third laying year, which received 0.2 mg. of carotene (approximately 333 U.S.P. units of vitamin A) per bird daily throughout the 3-year period.

The slight increase in egg production and hatchability during the third year is not considered significant. The mortality, which was highest on the higher level, was due to causes other than vitamin A deficiencies with peritonitis, leukemia, and reproductive disturbances being the principal causes.

During the past year a second series of trials checking the livability of chicks from hens receiving the different levels of carotene has produced results in close agreement with a former series. When fed a vitamin A-free diet, the chicks from hens receiving the 0.2 mg. level died at an earlier age than those from hens receiving the 0.5 mg. intake. While the lower level of carotene intake was sufficient to promote normal hatchability, it did not provide as much carryover in the chicks as the higher level.

The results of several years' work in cooperation with the Department of Agricultural Chemistry on this project indicate that the actual vitamin A requirements of laying hens are not so high as previously thought. The data emphasize the fact that the unstable nature of carotene and true vitamin A constitutes the real problem in this phase of poultry nutrition. *(J. K. Williams, C. E. Lampman, D. W. Bolin.)*

Carotene Requirements of Growing Chicks Determined

Comparable lots of single comb White Leghorn chicks were given varied levels of carotene intake supplied by dehydrated alfalfa of known potency added to the ration daily in amounts to provide 25, 50, 75, and 100 micrograms of carotene per hundred grams of ration. The average weight of pullet chicks at 8 weeks was 508, 548, 576, and 601 grams respectively for each of the above lots. The 25 microgram level proved to be marginal. A few preliminary deficiency lesions appeared, but there was no evidence of marked A avitaminosis and the chicks continued to make consistent gains throughout the 16-week period.

There was a marked improvement in the average weights, general appearance, firmness of flesh, quality of feathering, and depth of shank pigmentation with increased carotene intake. One hundred micrograms of carotene per hundred grams of ration appeared to be adequate for normal growth and general physical condition.

Two additional groups were included in which the alfalfa was added to the ration every 2 weeks in sufficient quantities to provide 50 and 100 micrograms of carotene per hundred grams of ration respectively. The feed was kept at room temperature (70 to 75 degrees F). The weights of the chicks at 8 and 16 weeks were slightly less than those on the same levels with alfalfa added daily, indicating a slight loss of carotene in the ration during the 2-week interval. The chemical analyses for this project were conducted by the Department of Agricultural Chemistry. *(C. E. Lampman, D. W. Bolin.)*

Carotenoid Pigments in Alfalfa not Needed When Ration Adequately Supplied with True Vitamin A

To determine how beneficial carotene or other carotenoid pigments contained in alfalfa might be in a white grain ration in which vitamin A was supplied by cod liver oil necessary for vitamin D protection, four duplicate lots of single comb White Leghorn pullets

were treated as follows: Lot 1 received the white grain basal ration; and in Lots 2, 3, and 4, dehydrated alfalfa was added to provide 0.05, 0.1, and 0.2 mg. of carotene per bird daily. All rations contained a biologically tested cod liver oil concentrate (400 D, 3000 A) at the rate of 0.25 per cent of total feed intake. The mash was mixed every 2 weeks. The alfalfa was of good quality so that it required only slightly more than 1, 2, and 4 per cent to provide the above carotene levels.

There were no significant differences in egg production, mortality, or general physical condition of the birds throughout the 11-month period. Egg production averaged over 60 per cent in all lots; the mortality ranged from 0 to 4.5 per cent. The results demonstrate that when cod liver oil of a guaranteed potency is used to supply adequately the vitamin D requirement of laying hens, it will also supply the vitamin A requirements when the mash is mixed frequently. The uncertainty of the future supply and price of cod liver oil has stimulated interest in commercial vitamin D supplements that contain no vitamin A. It is logical to expect that the quality of alfalfa with respect to carotene content and the supply and price of the various fish oils will influence the extent to which these products will be used in poultry rations. If irradiated products come into use as a source of D, then alfalfa of good quality will become more important in meeting vitamin A requirements. The chemical analyses for this project were conducted by the Department of Agricultural Chemistry. *(C. E. Lampman, D. W. Bolin.)*

Low Mortality of Station Flock Influenced by Reduced Virulence of Infection

Last year it was reported that the annual pullet-year mortality of the Experiment Station flock of single comb White Leghorns had decreased from 44.6 per cent in 1933 to 7.1 per cent in 1939. Fowl paralysis was the major disease involved during the earlier years of the study. While a certain amount of specific resistance has been demonstrated through selective breeding, it was not definitely known to what extent the low mortality during recent years might have been due to the decreased virulence of the disease complex.

In order to further study these factors progeny was introduced in the spring of 1939 from a private breeder's flock which had previously proved to be highly susceptible. Additional stock was introduced from a cooperating experiment station working on the mortality problem.

A comparison of the mortality of birds from the three sources during the first laying year (October 1, 1939 to September 1, 1940) is shown in Table 7. The low mortality in all three groups indicates that no serious infectious disease condition existed in the Experiment Station flock during that period. The mortality of the pullets introduced from the flock formerly susceptible was 15.58 per cent as compared to 42 per cent of the pullets introduced from the same flock in 1934-35. The few cases of paralysis indicates that this disease was still present but in a low state of virulence. Leu-

kemia, which most authorities consider a phase of the paralysis complex, proved to be the single major cause of mortality. The extremely low mortality of 3.5 per cent for the Experiment Station flock is such an unusual record that it is not likely to be duplicated.

Table 7.—Summary of laying flock mortality for 910 Leghorn pullets during 1st laying year (11-month period) October 1, 1939 to September 1, 1940

	Total Mortality		Portion of total mortality due to various causes									
			Paralysis		Leukemia		Peritonitis		Reproductive		Miscellaneous	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Flock A												
763 birds	27	3.53	1	3.7	6	22.2	3	11.1	6	22.2	11	40.7
Flock B												
103 birds	16	15.5	2	12.5	4	25.0	3	18.7	1	6.2	6	37.5
Flock C												
44 birds	3	6.8	1	33.3	1	33.3	..	.....	1	33.3	....	.....

Flock A—The University of Idaho poultry flock
Flock B—Introduced from a private breeder
Flock C—Introduced from a cooperating experiment station

Progeny from the Experiment Station flock was sent to two cooperating stations for the purpose of comparing mortality. Specific data has not yet been received; however, preliminary reports are to the effect that at one station the stock has exhibited a marked resistance to the paralysis-leucosis complex that is being studied there. At the other station the stock has suffered a relatively high mortality.

A logical conclusion, based upon the past year's records, is that the low mortality of the flock during the past 2 years at this station has been the result of several contributing factors including disease resistance acquired partly by the natural survival of resistant individuals and further developed by selective breeding, good management practices, and a decrease in the virulence or disappearance of the disease complex responsible for the high mortality rate from 1933 to 1937. *(J. K. Williams, C. E. Lampman, G. C. Holm.)*

Orchard Grass has Perosis-Preventative Properties

Previous reports from this Station have shown that orchard grass contains approximately four times as much manganese as alfalfa. It was reported that orchard grass meal, high in manganese, was effective in preventing perosis when used at the rate of 5 per cent of a perosis-producing basal ration. Recent trials have been conducted to compare the efficiency of orchard grass meal (370 p.p.m. manganese) with manganese sulphate salt in preventing perosis in growing chicks. Each was used in a deficient basal diet to supply manganese at the two levels of 17.5 and 25.0 p.p.m. Single comb White Leghorn chicks were used and negative and positive controls were included. Orchard grass used to supply 25 p.p.m. resulted in 100 per cent protection; manganese sulphate at the same level gave only 70 per cent protection. On the levels of 17.5 p.p.m., 70 per cent of the chicks receiving orchard grass and 38 per cent of the chicks receiving manganese sulphate were normal.

The results suggest that orchard grass may contain some ingredient other than manganese which has perosis-preventing properties or that the manganese in orchard grass was more efficiently utilized. *(C. E. Lampman, D. W. Bolin, Ella Woods.)*

Crops, Crop Breeding and Soils

Another Crop Year Low in Rainfall

THE crop year (September 1, 1939 to August 31, 1940) was characterized by low rainfall and higher than normal temperatures. The autumn months were especially dry. The winter and early spring months had more than normal precipitation, very little snow, and temperatures decidedly above normal. May and June were exceptionally dry and hot. Fortunately the month of July had a rainfall of 1.46 inches, 0.90 above normal, and temperatures but slightly above normal. *(K. H. Klages.)*

Low Rates of Seeding Increase Seed Yields of Sod-Forming Grasses; Non-Sod-Forming Grasses Produce Better Yields with Increased Rates

A rate of seeding test on various grasses extending over a period of 4 years was concluded this year. The results obtained are well illustrated by a comparison of seed yields of smooth brome grass, a sod-former, and crested wheat-grass, a non-sod-forming grass. The comparative seed yields of these two grasses by years are shown in Figures 4 and 5. The total seed obtained over the 4-year period of the test in the case of brome grass were 2,322 with 4 pounds; 2,166 with 8; 2,019 with 12; 953 with 16; and 1,760 pounds with 20 pounds of seed per acre. The opposite trend is found in the case of crested wheat, namely 2,143 with 4 pounds; 2,351 with 6; 2,207 with 8; 2,656 with 10; and 2,641 pounds of seed per acre with the seeding of 12 pounds.

The lower yields of the grasses during the last 2 years of the test should not be attributed to the increasing ages of the stands. Both 1939 and 1940 were extremely unfavorable to the growth of grasses. Droughts during May and June served especially to reduce seed yields. *(K. H. Klages.)*

Marida, a New Variety of Oats for Northern Idaho, Distributed

This year 475 bushels of Marida oats were distributed to the farmers of northern Idaho. The name Marida was derived from the combination of the names of the two parents of this new oats, Markton and Idamine. The cross giving rise to this oats was made at the Aberdeen Branch Station by G. A. Wiebe, Agronomist of the Bureau of Plant Industry of the U. S. Department of Agriculture. The progenies of the cross were grown in the oats observation nurseries at Aberdeen for a number of years. Marida C.I. Sel. No.

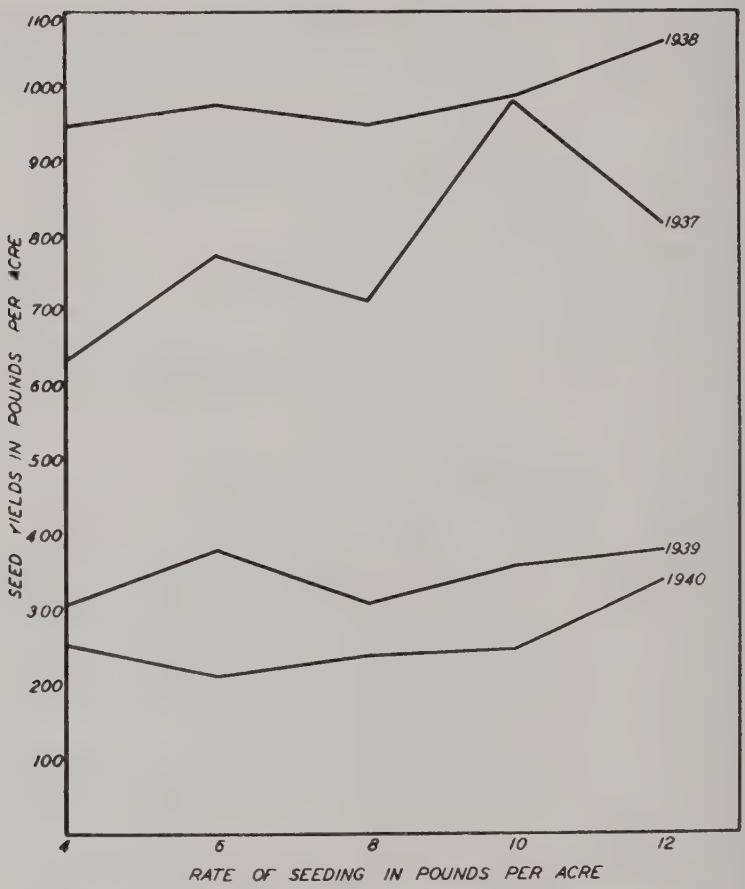

Figure 4.—Yields of crested wheatgrass seed per acre with rates of from 4 to 12 pounds per acre for the years indicated.

2571 and a number of other promising segregants of the same parentage were transferred to the University Farm at Moscow in 1929 for more extensive tests under northern Idaho conditions.

Table 8 gives the yields of Marida and the two parent varieties for two 6-year periods, 1929 to 1934 and 1935 to 1940. It is interesting to note that Marida showed a greater superiority over its parents during the second than during the first period of comparison. Over the 12-year period of the test the average yield of Marida was 87.5 bushels as compared to 79.5 bushels for its Markton and 78.7 bushels for its Idamine parents.

Marida is superior to its parents not only from the standpoint of greater yielding capacity, but also from the standpoint of having

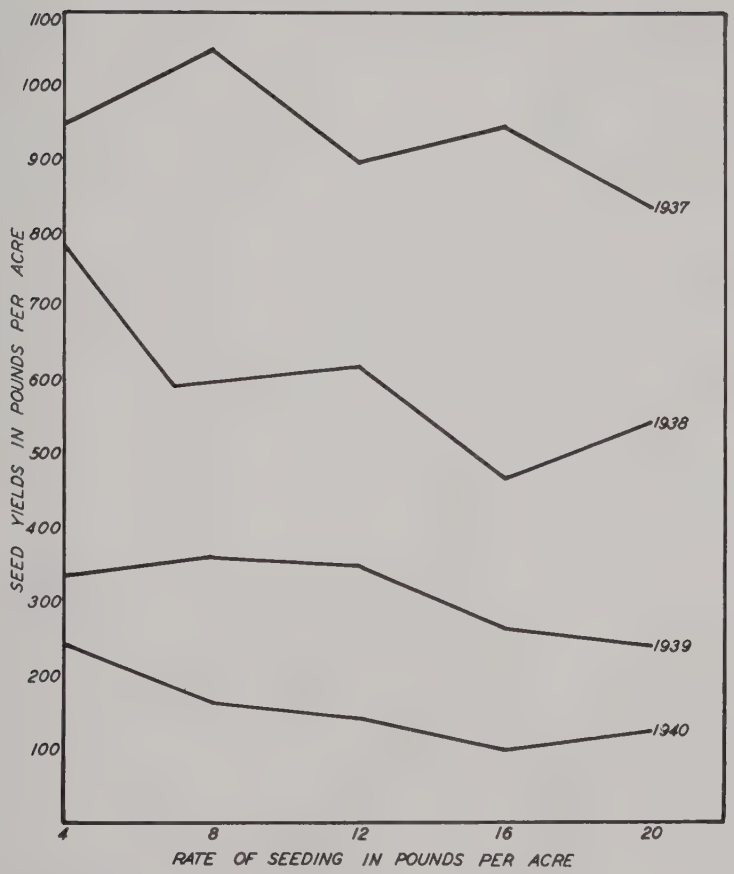

Figure 5.—Yields of brome grass seed in pounds per acre with rates of seeding from 4 to 20 pounds for the years indicated.

a stiffer and shorter straw and greater resistance to smut. Dr. C. S. Holton, Associate Plant Pathologist of the Bureau of Plant Industry, U. S. Department of Agriculture, stationed at the Washington Agricultural Experiment Station, Pullman, reports Marida more highly resistant to smut than Markton. Marida is an early-maturing oat, with stiff straw, a white kernel, and has a high per cent of berry to hull.

Marida is recommended for northern Idaho conditions—that is, for the territory north of the Salmon River. Under irrigated conditions in southern Idaho, Bannock, a new variety developed from a cross between Markton and Victory by the Office of Cereal Crops and Diseases of the U. S. Department of Agriculture at the

Aberdeen Branch Station and released by that station in the spring of 1938 is superior to Marida. Marida matures too early to produce the best yields under irrigation. *(C. A. Michels.)*

Table 8.—Comparative yields of Marida oats and the yields of its two parents for two periods of comparison on the University farm for the years indicated.

Variety	Yield in bushels per acre 1929-1934							Per cent of Markton
	1929	1930	1931	1932	1933	1934	Av. Yield	
Marida	54.4	86.2	73.3	114.2	103.1	78.0	84.9	102.04
Markton	80.6	83.4	66.6	116.8	85.3	66.3	83.2	100.00
Idamine	71.4	69.6	59.4	114.6	98.5	57.4	78.5	94.35
	Yield in bushels per acre 1935-1940							
	1935	1936	1937	1938	1939	1940	Av. Yield	
Marida	87.5	86.6	113.0	87.1	84.6	81.5	90.1	118.71
Markton	73.0	66.3	133.0	87.0	66.6	79.2	75.9	100.00
Idamine	78.1	69.7	106.6	47.0	72.2	99.8	78.9	103.95

Relatively Wide Interval Between Cultivations Gives Better Results than Closer Intervals in the Eradication of Bindweed

Continuous cultivation has resulted in complete eradication of bindweed in from two to four seasons depending upon weather conditions, location, and frequency of cultivation. The relationship between frequency of cultivation and both the number of cultivations and the time required to kill are given in Table 9 and shown graphically in Figure 6. The plots were considered to be emerged when two plants could be found on a 1/20-acre plot. All cultivations were made with a duckfoot field cultivator at a 4- to 5-inch depth except the original plowing of 6 to 7 inches. Cultivations at intervals of 12 days after emergence have resulted in a saving of over one year in the time required to kill, and nearly sixty cultivations over the old black fallow method. Under ordinary farm conditions this would mean that the bindweed infested areas should be cultivated at intervals of from 14 to 16 days. Wider intervals than 16 days after emergence are being studied, as well as continuing the narrower frequencies to measure year-to-year variations. Frequency of cultivation experiments is only one phase of a large program of investigation of methods of control and eradication of noxious weeds being conducted cooperatively with the Bureau of Plant Industry of the U. S. Department of Agriculture. *(C. I. Seely, K. H. Klages.)*

Table 9.—The influence of frequency of cultivation on the number of cultivations and time required to eradicate bindweed under continuous cultivation. Average of experiments started in 1937 and 1938

Frequency of cultivation	Number of cultivations required to kill	Number of months required for eradication
At emergence	81	37
4 days after emergence	45	33
8 days after emergence	31	31
12 days after emergence	22	21
16 days after emergence	25	32

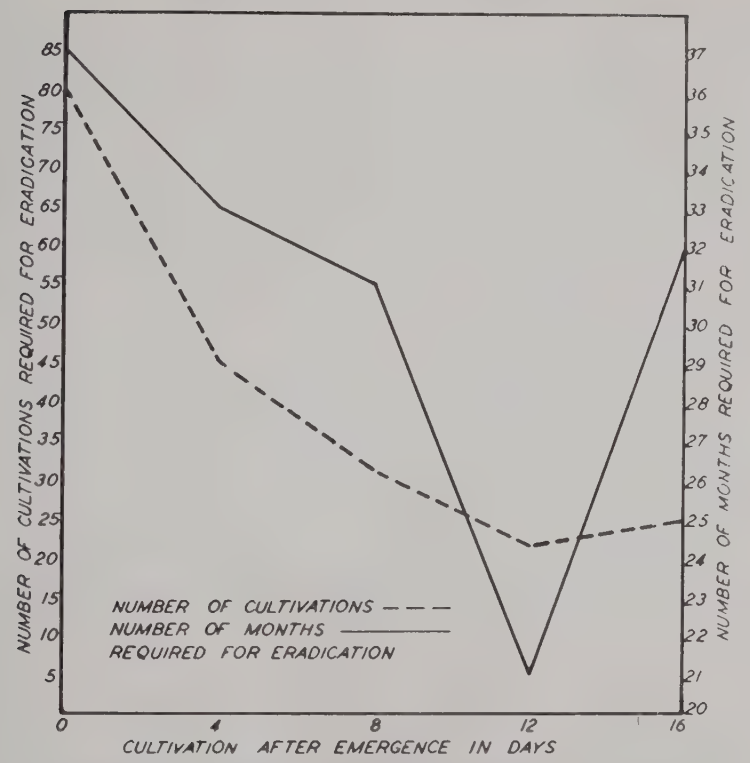

Figure 6.—The influence of frequency of cultivation on the number of cultivations and time required to eradicate bindweed under continuous cultivation.

Corn Belt Hybrid Seed Corn Not Always Superior in Yield to Native Selected Open Pollinated and Single Crosses

Extensive field tests conducted for 3 years at the Caldwell Branch Station indicate that a synthetic yellow dent strain of corn composed of a number of 2-year selfed lines, and single crosses developed from a 4- to 6-year selfed lines are superior in yield and quality to out-of-state hybrid strains. The average for the field tests gave the following results: Open pollinated synthetic strain yielded, 120.1 bushels; Idaho single crosses, 116.9 bushels, as compared to 108.9 bushels per acre for out-of-state hybrids.

These results and observations made on cooperative hybrid corn tests on farms in the different corn-growing sections in Idaho indicate that native adapted strains frequently produce better yields of marketable corn than do the out-of-state non-adapted hybrids. *(C. A. Michels.)*

Organic Matter Additions to Soil Very Important

Organic matter additions, supplied by barnyard manure, have given some outstanding results on the long-time rotation investigations at the Main Station at Moscow. Measurable results have been obtained on the influence of manure on crop yield, protein content of wheat, soil organic matter, and soil and water losses. The following results are based on the application of 15 tons of ordinary barnyard manure every third year. The figures cited are based on a 15-year average, 1924-1938, inclusive, although the rotation investigation has been in progress for 26 years.

Effect on Yield

The average of two comparable 3-year rotations producing a crop every year shows that the manure addition increases the wheat yield by 16.5 bushels and the oat yield by 16.6 bushels per year. Where continuous wheat has been grown, the manure addition increased the yield by 11.8 bushels.

Effect on Protein Content of Wheat

Considering the average of the two 3-year rotations, manure additions increased the average protein content of the wheat by 2.41 per cent over the unmanured. Manure on continuous wheat increased the average protein content 1.21 per cent.

Effect on Soil Organic Matter

Considering the average of the two rotations and continuous wheat plots, the addition of manure shows an average increase for the 15 years of 4,000 pounds of soil organic matter per acre. During this same 15 years the comparable unmanured treatments showed an average decrease of 2,800 pounds of soil organic matter.

Effect on Soil and Water Loss

Through cooperation with the Soil Conservation Service of the U. S. Department of Agriculture, run-off tanks have been placed on the continuous wheat plots. Considering the 4 years on which data has been obtained, the additions of the manure reduced the water loss to 55 per cent and soil loss to 33 per cent of that suffered by the unmanured plots.

The use of green manure crops as a source of organic matter is also being investigated at the Main Station. The tests have not been established a sufficient length of time to draw conclusions. However, all indications are that similar results to those obtained with manure can be expected by the proper use of green manure crops.

The use of barnyard manures, green manures, and crop residue are also being investigated at the Sandpoint and Tetonia Branch Stations. *(G. O. Baker.)*

Soil Survey Work in Gem County Progressing Slowly

The soil survey program conducted in cooperation with the Bureau of Plant Industry, Soil Survey Division, in Gem County, is progressing rather slowly due to the multiplicity of factors which must be considered in the area. Additional funds should be made available for speeding up the soil survey program, as it is a fundamental and vital part of nearly all of the farm programs now in operation. *(G. O. Baker.)*

Commercial Fertilizers Should Be Used as a Supplement to Rotations and Manures

The use of commercial fertilizers, as a supplement to the proper use of rotations, green manures, barnyard manure, and crop residue, are being investigated at the Main Station, and at Aberdeen, Caldwell, and Sandpoint Branch Stations. Indications to date are that, under average farming conditions, it is economical to supplement rotations and manures with adapted commercial fertilizers. Phosphorous is the plant food element most often limiting crop production in much of Idaho. Nitrogen additions have given economical returns on intensive crops, as onions, etc., and needs to be given more consideration. Potash has given response only in local areas but in all probability will become more important as time goes on. The fertilizer response obtained on the individual farms should be determined or verified by a small test plot on the farm in question. *(G. O. Baker.)*

Alfalfa Yellows Easily Cured

Alfalfa yellows, which is caused by a deficiency of available boron in the soil, can be easily controlled by the use of small quantities of agricultural borax. A summary of findings of 3 years' investigations and recommendations were published as Mimeo-Leaflet No. 47 of the Idaho Agricultural Experiment Station. *(G. O. Baker.)*

Fruit and Vegetable Crops

Fruit By-Products Promise Outlet for Surplus

FRUIT men of Idaho are well aware of the need of by-products outlets for cull and surplus fruits, especially in seasons of heavy production. Several years ago, the Idaho Agricultural Experiment Station secured the assistance of the Fruit and Vegetable By-Products Laboratory of the U. S. Department of Agriculture, located at Pullman, Washington, and serving the states of the Pacific Northwest, to investigate possible by-products outlets for

surplus apples, prunes, and cherries in Idaho. Under this cooperative arrangement there has recently been developed by the Federal Laboratory a product known as "prune nectar," made at relatively low cost from either cull or marketable prunes. Prune nectar is both a refreshing drink and a wholesome, nourishing food. It is about the consistency of commercially canned tomato juice and can be produced to sell at a comparable cost, with a liberal allowance to the grower for the fruit used. Detailed specifications for the commercial production of prune nectar have been worked out and are available to private or grower-operated canneries interested in this product. Other products investigated include prune marmalade, sweet cherry juice, and apple cider blends. *(Leif Verner, Carl F. Dietz.)*

Variety Testing of Fruits and Vegetables Conducted

Since earliest times, the most important and lasting gains in the field of horticulture have been made through the development and introduction of improved varieties of horticultural plants. To determine the relative merits of hundreds of new and old varieties of tree fruits, small fruits, and vegetables for Idaho growers, extensive variety test plots were established by the Idaho Agricultural Experiment Station in 1937 at Moscow and Parma. Performance records have already been secured on 47 varieties of strawberries, 44 varieties of brambles, 30 varieties of grapes, over 100 varieties of head lettuce, and on smaller numbers of various other crops, including carrots, onions, potatoes, peas, etc. The first of over 200 stone fruit varieties and nearly 100 varieties of apples, many of which were originated by the Idaho Agricultural Experiment Station, bore fruit this year, and practically all of these should be in bearing by 1941. While major emphasis has been laid on varieties likely to be of commercial importance in Idaho, attention has been given also to varieties of value for home use, especially for the colder climates of our high altitude districts where few fruits of any kind are now grown. Twenty-four varieties of tree fruits and small fruits have been on trial at the High Altitude Branch Station at Tetonia since 1938. *(Leif Verner, G. W. Woodbury, Carl F. Dietz.)*

Hastening Maturity of Potato Tubers Profitable

Failure of potato vines to die down at the desired time from natural causes often confronts the grower with a choice of digging the tubers before they are mature or running the risk of loss from leaving them too long in the ground. For the grower of early potatoes, there is a risk of loss through low prices by delaying harvest until the tubers ripen naturally. For the grower of main-crop potatoes in some parts of the state, there is a risk of loss from freezing in the ground if the tubers do not ripen in time to dig reasonably early in the fall.

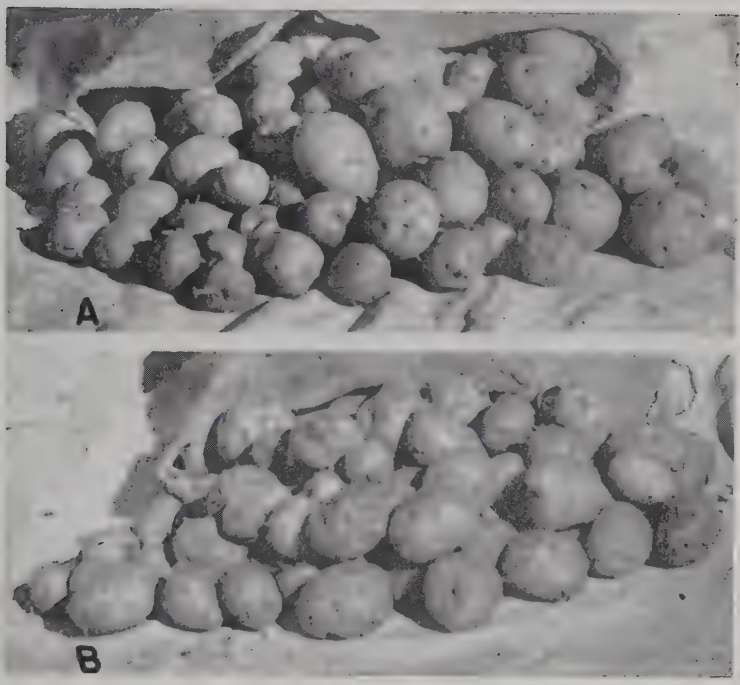

Figure 7.—Bliss Triumph potatoes at time of harvest. A—well matured tubers from vines killed by ammonium sulphate spray ten days before digging. B—immature, badly scuffed potatoes from untreated vines.

When a tuber matures after death of the vine, changes take place in the periderm or "skin" that make it thicker and less easily sloughed off in digging and handling operations. Two years' study at the Parma Branch Station indicates that these changes leading to a proper ripening of the tuber can be induced artificially at the desired time by killing the vines with any one of several different kinds of sprays. Figure 7 shows two samples of Bliss Triumph dug at the same time, and clearly demonstrates the effects of increased maturity of the skin on tubers from vines treated 10 days previously.

One of the most effective sprays for this purpose has been ammonium sulphate used at a concentration of 1 pound per gallon of water and applied at a rate of 200 gallons per acre. Microscopic examination of tubers dug at frequent intervals following the death of vines by spraying indicates that normal ripening changes in the skin take place and that the potatoes can be dug 10 days after treatment without danger of damage due to lack of maturity. Killing of the vines by various other methods is also being tried. None of these methods has yet been developed to a point where it can be recommended for use except experimentally on a small scale.

An economical method of artificially inducing maturity of potatoes at will may make it possible for the grower of early potatoes to ripen his crop for digging at a time when market conditions are such as to assure a good return. Heretofore, the grower has had to either market his crop in an immature and badly scuffed condition in order to take advantage of high prices, or else delay harvest until the tubers are ripe and take whatever price prevails at that time. For the grower of main-crop potatoes, artificially induced maturity may solve the perplexing problem sometimes encountered in Idaho when the vines are not killed by frost early enough to permit harvesting until there is danger of severe freezing. *(Carl F. Dietz.)*

Carrot Seed Production Promising

Carrot seed production is a new agricultural industry in the warmer parts of Idaho. Because of large yield of high quality seed produced at a relatively low cost as compared to other parts of the United States, the carrot seed industry seems destined to a promising future.

With the advent of a new industry, many problems concerning cultural practices immediately arise. Among the problems that appear most important in carrot seed production in Idaho are differences in seed yield per acre due to the size of the carrot roots planted, the time of planting, planting distances, and handling and storage practices.

Figure 8.—Carrots for seed production. Left, roots planted in the fall; right, roots planted in the spring.

Trials at the Parma Branch Experiment Station have shown striking differences in yield resulting from planting roots of different sizes, and from planting at different dates. The roots used in these trials were grown during the summer of 1939 and were dug and sorted into three size groups in the fall. Roots of each size were planted the same fall, and duplicate plantings were made the following spring from carrots held over winter in a cellar storage.

From Table 10 it can be seen that there were tremendous differences in seed yields in favor of large size roots, and in favor of fall planting. *(See Figure 8.)* Since large size roots require the handling and storage of a correspondingly large tonnage of carrots, growers usually have attempted to grow roots of the smaller sizes. However, on the basis of current contract prices paid for carrot seed, there was an advantage of $52.12 per acre in favor of large size carrots over small size, and lesser advantages between large and medium, and between medium and small sizes.

Table 10.—Comparative yields of carrot seed from fall and spring plantings of small, medium and large roots. (Parma, 1940).

Variety	Date planted	Lbs. seed per acre large*	Lbs. seed per acre medium	Lbs. seed per acre small
Hutchinson (3)	Fall (a)	889.2	650.2	624
	Spring (b)	592.8	408	376
Morse Bunching (3)	Fall	440	364	426.2
	Spring	280	318	163
Imperator (1)	Fall	599.2	476	229.6
	Spring	249.2	264	198
Imperator (2)	Fall	824.6	617	431
	Spring	599	502.4	356.4
Imperator (3)	Fall	837	504	453
	Spring	487	226.4	226.4
Nantes (3)	Fall	403.2	377.4	354.2
	Spring	319.6	297.6	219.2
Oregon Chantenay (3)	Fall	649	648.4	490
	Spring	449.6	517	313.6
Red Cored Chantenay (3)	Fall	640	462	280
	Spring	400	462	180

(1) Porters Variety Trial, 1939
(2) Ferry Morse Seed Company
(3) Crookham Seed Company
* Large—Diameter, 3 inches and above; Medium—2 to 3 inches; Small—1 to 2 inches.
(a) Fall—Planted November 14 & 15, 1939.
(b) Spring—Planted March 17 & 18, 1940.

Not only has fall planting of carrot roots resulted in much greater yields than spring planting, but it also has served to eliminate the cost of winter storage and to greatly reduce loss from certain diseases that tend to develop and spread under storage conditions. Unfortunately, since the initiation of this experiment, there has not been a severe test winter at Parma, and, consequently, there is no information yet as to the survival of fall planted roots at the lowest temperatures that might be experienced. The use of a straw mulch to afford additional protection in the event of very low temperatures has been introduced as another phase of this experiment.

Until results have been secured under the most severe winter conditions likely to be encountered in the region, a general recommendation of fall planting of carrot roots cannot be made. *(G. W. Woodbury, Carl F. Dietz.)*

Agricultural Engineering

Land Reclamation and Conservation Research Continued

A REPORT of the 1939 study of irrigation and drainage pumping plants was made the basis of plant improvement and modernization with a reduction of costs for power. This study assisted in formulating a new power rate schedule for irrigation pumping in southern Idaho. A continuation of the studies indicated the probability of failure of some wells by shifting or collapse of casings.

Cooperative studies at the Aberdeen Branch Experiment Station showed no significant differences in yields of potatoes resulted from irrigation with cold well water instead of the warmer ditch water.

Pumping on the Aberdeen Springfield Canal Company's system at Aberdeen, Idaho, was resumed for the first time since the serious drought in 1934. This was made possible by the reduction in seasonal demands from 6 to 3 months, permitting the short-time use of electric power. In 1940, a record of four plants operated by the Aberdeen-Springfield Canal Company showed that 2 months' operation of these units added about 32,400 miners' inch days to the system's water supply.

In cooperation with the Soil Conservation Service of the U. S. Department of Agriculture, a report was completed on intensity-duration-frequency of rainfall in Idaho. A table for use by engineers in estimating rates of runoff for watersheds of varying size and runoff factors was finished. A soil sampling auger was developed for securing undisturbed soil cores for laboratory rates checked with rates measured in the field. *(Hobart Beresford, J. P. Bonner, Mark R. Kulp, James C. Marr, John L. Toevs, William Watson.)*

Field Power and Machinery Studied

Work was continued on the harvesting and threshing of vegetable and field crops, including the threshing requirement for castor beans. A study was made on the selection, installation, and management of seed cleaning and grading equipment. The design of seed plot threshers was simplified and improved, also an air pressure type rubber roll method of threshing was developed.

In cooperation with the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture, a field study was made of the increasing practice of mechanized dusting of field peas for the control of weevil. The operation and management of equipment previously reported upon was continued and new developments

in design and technique of application observed. During the past season more than one hundred machines operated in the Palouse area, applying approximately 700,000 pounds of dust for the control of the weevil. This application was on an estimated area of 120,000 acres. Wider coverage, reaching a maximum width of 72 feet, and higher field speed of 8 miles per hour were secured by this type of equipment. Lighter welded construction and caster wheel booms are the outstanding features of the new dusting equipment.

A study of the mechanization of potato production included observation of 4-row planting and 2-row harvesting equipment. The timeliness factor, resulting from fully mechanized potato production operations, contributes to offset the harvesting hazards resulting from early fall rains and freezing weather. Four-wheel drive power units which have been developed for industrial contracting work have been applied successfully to the field power requirements of potato production. *(Hobart Beresford, T. A. Brindley, Leo M. Christensen, E. N. Humphrey, George W. Woodbury.)*

Rural Electrification Developments Rapid

The progress of rural electrification development in Idaho was reported in Idaho Agricultural Experiment Station Bulletin No. 237, which summarizes the research work in cooperation with the Idaho Committee on the Relation of Electricity to Agriculture. The data obtained by this study shows that Idaho has 64.20 per cent of all occupied farms and 87.44 per cent of all farms with dwellings valued at more than $500 receiving electric service. As of June 1940, there were 26,914 Idaho farms receiving electric service with a total of 38,273 farm and other rural customers served by 7,043.74 miles of distribution line. Data obtained on the hydroelectric power development indicated that 76 hydro plants had a combined capacity of 387,927 horsepower which fully meets the state's present power needs. According to estimates of the United States Department of the Interior, there are 2,706,000 undeveloped horsepower available 90 per cent of the time.

The study of the government-financed lines in Idaho revealed that the R. E. A. in Idaho has a number of associations furnishing service to a total of 3,155 farm and other rural customers served by 1,690.05 miles of distribution line. This represents about one half of the potential membership which was used as the basis of the allotments received by these associations for the construction of distribution lines totaling $2,505,250 for Idaho.

In connection with the investigation of farm refrigeration requirements, it was found that Idaho has 100 frozen locker storage plants with an estimated capacity of 27.000 lockers. Eighty of these plants were being conducted in connection with some other business such as grocery, dairy, or creamery and 20 were operated as independent units. Ninety-three were privately owned, and 7 were cooperatives. The 1940 survey shows that 10 plants were discontinued while 22 new plants were started.

The analysis of farm refrigeration requirements indicated that the solution of frozen storage on the farm will be a compromise between what the farmer desires and what he is willing to pay for. As a result of these studies, plans were made for a 20-cubic foot lift-top box and a 45-cubic foot reach-in two-temperature box equipped with three doors and a combination shelf-type cooling coil for the frozen storage section. Also, plans are available for a farm-made walk-in cooler providing a frozen storage compartment. The material for the construction of the 10-cubic foot size of storage box, with the motor and compressor unit, costs from $125 to $150, not including the cost of labor. Commercial units of similar size may be purchased for about $250. The farm-made 20-cubic foot box can be constructed for about $150 to $200, including the motor and compressor unit. A similar capacity commercial-type frozen storage box will cost from $300 to $500. The larger commercial walk-in coolers provide 350 to 500 cubic feet of space, costing from $500 to $800.

Laboratory tests were made on electric heating devices for livestock and poultry drinking water, also for dairy sterilizing and steam generating equipment. Preliminary work was done on the development of electric fly control equipment for dairy barns and on the use of radiant energy for drying fruits and other agricultural products. *(Hobart Beresford.)*

Farm Building Plans Prepared

Work was continued on the development of humidity control units for incubator rooms and on the heating and ventilating of animal shelters, especially the use of circulation-type electric heaters for poultry houses. A study was made of the structural and functional design of potato storages, including a field study of the design and function of mechanical equipment in the handling, sorting, grading, washing, sizing, packaging, and shipping of potatoes. Plans were developed for the construction of a combination chopped hay storage and feeding barn and the adaptation of the conventional type of loose hay racks to chopped hay feeding. Plans for special equipment for poultry production were prepared in connection with the publication of "Housing Farm Poultry" and "Practices for Conserving Egg Quality." *(Hobart Beresford, Kenneth H. Parks.)*

Farm Economics

Efficiency Factors on Wheat Farms in the Teton River Basin Determined

UPON the request of the County Land Use Planning Committee of Teton County, this study was made early in 1940. As a source of facts relating to these farms, farm business records were taken on more than half of all dry-land wheat farms in northern

Teton County and adjoining wheat areas in Madison and Fremont Counties. Table 11 shows some results of this study. The most important factors facilitating high net farm income and operator's labor earnings were: number of acres of crop land, number of productive man work units per year, number of productive man work units per man, and crop production index of yields per acre.

Except in two of five types of areas studied, the number of animal units per farm was in inverse ratio to net farm income. Payments from AAA were higher, as a percentage of total returns, on the larger farms because of a larger proportion of crop land devoted to wheat. In the case of most of the smaller farms, AAA payments represented most, if not all, that remained for the farmer's labor income after all other expenses were paid in 1939. Farms with larger acreages could have been operated to advantage with reduced or even omitted AAA payments. The same conclusions were reached when estimates based upon long-time average yields and 5-year-average prices and costs (1935-39) were used. *(P. A. Eke, Leo Fenske.)*

Table 11.—Earnings, size of business and efficiency factors compared on Teton County farms, classified by areas, 1939

Item	Area 7			Areas 8-9		Area 10		Area 13	
	Upper one-third	Middle one-third	Lower one-third	Upper half	Lower half	Upper half	Lower half	Upper half	Lower half
Number of farms	15	14	15	6	6	3	4	4	4
Earnings									
Total farm receipts	$ 7,248	$ 4,792	$ 2,850	$ 4,160	$2,374	$1,844	$1,511	$2,504	$1,182
Total farm expenses	3,251	2,777	2,290	1,804	1,700	820	1,237	1,565	925
Net farm income	3,997	2,015	560	2,356	674	1,024	274	939	257
Operator's labor earnings	3,373	1,593	115	1,962	343	804	203	680	128
Size of business									
Total acres operated	1,239	715	715	695	665	253	247	506	178
Acres of crop land	981	593	462	526	376	149	200	349	125
Total animal units	8.5	10.7	14.7	11.4	15.3	27.1	10.3	19.2	13.4
Total investment	$14,564	$10,443	$10,304	$10,374	$7,662	$5,081	$2,672	$6,423	$3,324
Livestock investment	491	545	774	645	948	1,652	583	1,234	791
Machinery investment	3,548	3,074	2,901	2,369	1,468	1,012	674	1,530	873
Total P.M.W.U.	324.1	237.2	271.7	257.2	176.4	358.1	153.9	340.4	179.8
Man equivalents	1.2	1.1	1.4	1.3	1.3	1.7	1.0	1.8	1.6
Efficiency factors									
P.M.W.U. per worker	270.1	211.8	190.0	202.5	135.7	208.2	153.9	192.3	113.8
Crop production index	112.2	112.2	91.4	91.5	100.1	80.6	65.8	93.8	57.8
Gross ratio	44.9	57.9	80.4	43.4	71.6	44.5	81.9	62.5	78.3
Mach. invest., crop acre	$3.62	$5.18	$6.28	$4.50	$3.90	$6.79	$3.37	$4.38	$6.98
Gross inc., $100 capital	49.76	45.89	27.66	10.10	30.98	36.29	56.54	38.98	35.56
Gross inc., per crop acre	7.39	8.08	6.17	7.91	6.31	12.38	7.56	7.17	9.46
Sources of income									
Percentage from crops	71.9	64.2	56.5	57.9	46.6	7.2	19.4	46.4	19.9
Percentage from livestock	3.7	8.3	10.2	8.5	28.1	34.1	22.6	10.3	47.8
Percentage from AAA	18.1	14.9	15.6	23.4	16.2	8.0	4.0	10.8	9.0

Feasibility of Supplementing Spring Run-Off Irrigation Water Determined

A dam for increasing spring run-off irrigation water on Mann's Creek in Washington County has been considered by residents of that community for several years. In 1938, a request was made through the community's Land Use Planning Committee to the

Idaho Experiment Station that a study be made to determine, if possible, what this additional water would yield in additional farm returns. These derived estimates of additional farm returns in the area, which would result from the additional water, were compared with the estimated cost of the dam.

Table 12 illustrates the research method used and gives estimated differences in farm income and labor income due to changes in cropping practices and yields made possible by all-season irrigation. It is shown that all-season irrigation water will increase farm income, labor income, and operator's earnings whether the customary crops of the area are grown or whether new crops are grown which are made possible by additional water. With a change to sugar beets and more livestock, it is estimated that farm income can be increased by several hundred per cent. It is not anticipated that all this increase can be budgeted for the payment of water because higher grade management demanding larger compensation will be required. These conclusions agree with estimates made by the Bureau of Reclamation in the same community. In this way this study has given added assurance to the farmers and to the Bureau in proceeding to construct the dam and apportion costs among the farm owners. *(P. A. Eke)*

Table 12.—Farm records and budgets on a typical farm in Mann's Creek illustrating the possible increases in farm income from all-season irrigation in contrast to spring run-off. (Crop land: 88 acres irrigated, 32 acres dry)

Items	Farm income and expense[1]						
	Farm record 1938—spring run-off	Farm record 1938—5-yr. av. prices—spring run-off	1938 crops at normal yields—5-yr. av. prices—spring run-off	1938 crops—5-yr. av. prices—all-season irrigation	Sugar beet rotation—5-yr. av. prices—sold surplus feed—all-season irrigation	Sugar beet rotation—5-yr. av. prices—fed surplus feed to sheep and hogs—all-season irrigation	Sugar beet rotation—5-yr. av. prices—surplus feed fed dairy cows and hogs—all-season irrigation
Income from sales	$1,671.60	$1,998.65	$1,331.70	$3,369.10	$4,704.86	$6,885.96	$6,933.62
Current expenses	688.00	688.00	688.00	972.70	1,912.67	2,329.19	2,504.61
Balance	983.60	1,310.65	643.70	2,397.00	2,792.19	4,556.77	4,429.01
Depreciation, upkeep	202.00	202.00	202.00	350.00	443.00	590.00	540.00
Farm income	781.60	1,108.65	441.00	2,047.00	2,347.19	3,966.77	3,889.01
Interest on capital	426.40	426.40	426.40	454.86	461.40	560.20	573.90
Labor income	355.20	682.25	15.30	1,592.14	1,885.79	3,406.57	3,265.11
Family living	196.00	196.00	196.00	196.02	196.00	196.00	196.00
Outside earnings	28.00	28.00	28.00	.....	.....	.....	.....
Operator's earnings	579.20	906.25	239.30	1,788.14	2,081.79	3,602.57	3,461.11

[1] In all budgets the charge for water and interest on land was kept the same in order that an estimate could be made as to the amount available to pay for this water and provide a basis for added valuation of the land.

Fluctuations in Farm Income Studied for Years 1929 to 1940

One of the major problems of Idaho agriculture is the great fluctuations in farm prices and income from year to year. In order for farmers to adjust production to future conditions it is necessary for them to know the historical trends of these fluctuations.

Table 13 shows the estimated returns of three plans for meeting

fluctuations in potato and sugar beet prices. For the years involved, these three plans proved to be of different efficiencies in different years in arriving at the highest farm income. As an average for the 12 years, farm income was the greatest when the farm outlook information was used for adjustment of acreage. Sugar beet prices have fluctuated but little, so that most of the differences in income have arisen from a change in the acreage and price of potatoes. Average yields of potatoes and sugar beets have been used for budgeting all years in order to allow workable comparisons. Of course, yields on any particular farm vary from year to year according to weather conditions and other factors. *(P. A. Eke)*

Table 13.—A comparison of farm income which would have resulted if farmers had responded to potato outlook information, with farm incomes which could have been realized from two other plans of determining potato acreage for years 1929 to 1935 inclusive

Three plans, I, II, and III, for allotting acreages to potatoes and sugar beets are used for comparison on an 80-acre irrigated farm with loam soil on a project in southern Idaho.

Year	Weighted average price wagon load cash to growers per cwt., U. S. No. 1's at Idaho Falls	Plan I: Potato and sugar beet acreage held at 14.55 acres each for all years on 29.1 acres of cultivated crops. (80 acres)			Plan II: Potato acreage increased or decreased from Plan I in proportion to changes in Idaho potato acreage with the remainder of 29.1 acres planted to sugar beets. (80 acres)			Plan III: Potato acreage increased by 50 per cent from Plan I with favorable price outlook; and decreased 50 per cent with unfavorable outlook and held the same for other years. The remainder 29.1 acres is planted to sugar beets. (80 acres)		
		Acreage		Farm Income	Acreage		Farm Income	Acreage		Farm Income
		Potatoes	Beets		Potatoes	Beets		Potatoes	Beets	
1929	$1.98	14.55	14.55	$5,303.63	12.37	16.73	$4,824.10	21.83	7.27	$7,006.74
1930	.66	14.55	14.55	1,398.78	14.69	14.41	1,426.78	7.27	21.83	1,484.28
1931	.42	14.55	14.55	571.87	16.44	12.66	538.61	7.27	21.83	848.19
1932	.23	14.55	14.55	−188.36	14.84	14.26	−199.56	7.27	21.83	108.30
1933	.77	14.55	14.55	1,957.35	13.82	15.28	1,350.72	7.27	21.83	903.26
1934	.61	14.55	14.55	1,222.95	15.86	13.24	1,227.99	7.27	21.83	1,159.37
1935	.76	14.55	14.55	1,706.23	13.39	15.71	1,643.18	7.27	21.83	1,478.82
1936	1.82	14.55	14.55	3,957.12	15.97	13.13	4,235.79	21.83	7.27	5,368.94
1937	.43	14.55	14.55	1,176.22	18.68	10.42	1,100.80	14.55	14.55	1,176.22
1938	.61	14.55	14.55	1,040.17	17.33	11.77	1,062.91	21.83	7.27	1,079.93
1939	.79	14.55	14.55	1,560.58	18.68	10.42	1,693.66	21.83	7.27	1,795.87
1940	.60[1]	14.55	14.55	1,164.50	19.13	9.97	1,162.00	7.27	21.83	1,139.52
Total				20,889.04			20,166.98			23,549.44
Average				1,740.75			1,672.85			1,962.45
Increase in farm income over Plan II				68.50			00.00			322.29

[1] For the 1940 season a forecast has been made as to the price received for potatoes and other products sold in this budgeted farm business. This was necessary because the budget was made in October 1940.

Ways of Assisting Settlers on the Black Canyon Irrigation Project Studied

In order to fill the gaps in the information which has been necessary to permit the Bureau of Reclamation, the Farm Security Administration, the Extension Service, and other Federal and State agencies to adequately serve the needs of settlers on this and other new irrigation projects, this study was undertaken in the spring of

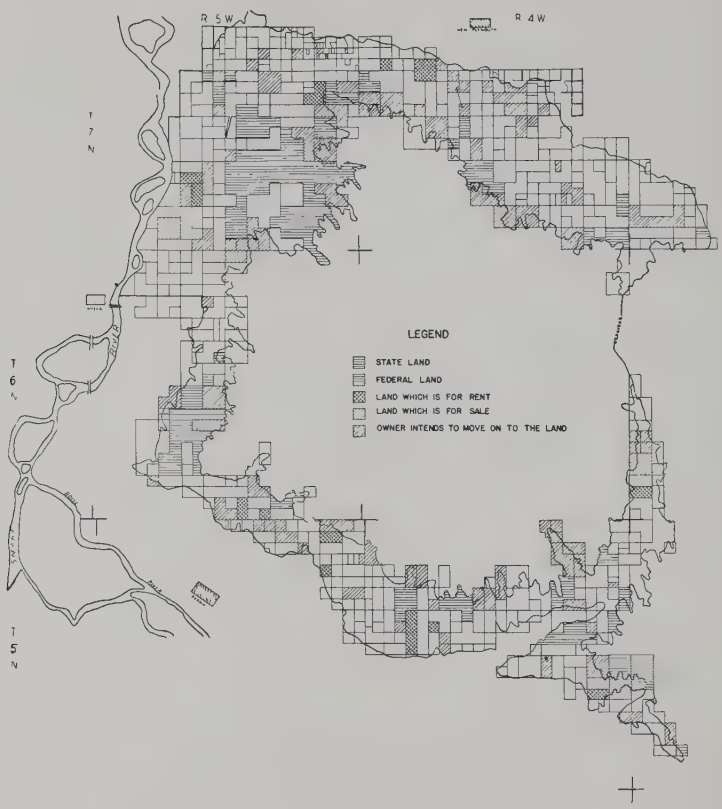

Figure 9.—Map of the gravity unit of the Black Canyon irrigation project showing owner's intent of land disposal in 1940.

1940. Figure 9 taken from Mimeo-Leaflet No. 45 of the Idaho Agricultural Experiment Station gives a picture of the gravity unit of the project as well as the owners' intentions respecting their land. The main limiting factor in the progress of the area as a whole, as well as in the progress of nearly all the individual settlers, was the shortage of capital. Housing, development of the land, purchasing equipment and livestock, and seeding the developed land were retarded, and often at a standstill, because of the lack of capital.

It is necessary to have available for the area a type of credit which permits an increasing loan for the first two or three years with small and increasing repayments provided for thereafter. Since the security for this type of loan must be created out of the loan and the labor of the settler, it is necessary that the lending agency be one that can give a great deal of supervision in the development and management of the land. Of the existing agencies, the Farm Security Administration seems to best meet these quali-

fications. Only if these credit practices are followed is it likely that reasonable progress can be made in developing paying farms and providing a tolerable level of living. *(P. A. Eke, Norman Nybroten)*

Farm Planning and Budgeting Continued in Dixie Dry-Land Community

In this dry-land area of about 50 farms in Washington County, farm budgeting work has been continued. This budgeting has been directing farmers toward more diversification. Action agencies have gained new confidence in extending their services to this community. It appears now that this community can become permanent and prosperous by following new farming systems worked out individually by the farmers themselves. These systems are being worked out with the aid and suggestions of extension specialists in all lines.

Some research is being carried on in the community under the direction of the Idaho Experiment Station, part of it by the farmers themselves, to find more adaptable crops, particularly pasture and forage crops. In this community there is now a fine example of unified action on the part of Federal, State, and County agencies and the farmers in solving farm and community problems. *(P. A. Eke)*

Agricultural Bacteriology

Cause and Control of Bovine Mastitis Studied

STUDIES have been continued concerning the etiology of bovine mastitis. It has been observed that micrococci are frequently associated with streptococci in chronic cases of udder infections. In order to understand better the relationship of these organisms to the disease, serological tests have been made with the blood serum and milk serum of infected animals. Antigen was prepared from miscellaneous cultures of micrococci isolated from cases of mastitis. In most cases some agglutination took place when blood serum was used, but it was not considered significant. Milk serum failed to agglutinate the strains studied.

Studies on the control and cure of bovine mastitis have been carried on in cooperation with the Departments of Dairy Husbandry and Animal Husbandry. Periodic bacteriological examinations have been made on the milk from all milking cows in the University herd in order to detect infected animals. The presence of more than 100,000 leucocytes per ml. of milk, together with long chain streptococci, was used as a criterion for detecting infected udders. When infected animals were detected, they were segregated from the other cows in order to prevent the spread of infection. In this manner it is hoped that the incidence of the disease will be reduced.

Animals that are known to be infected have been treated by the

station veterinarian. Treatments employed have included the use of diathermy, sulfanilamide and the injection of acriflavine. The effectiveness of treatment has been judged by bacteriological examination of the milk and by the physical condition of the cow's udder. While diathermy and sulfanilamide relieved some of the acute symptoms of mastitis, none of the methods used completely eliminated the causative organism from the udder. *(V. A. Cherrington, W. V. Halversen, G. C. Holm, D. L. Fourt)*

Pullorum Disease Studies Continued

Cooperative work has continued in the study and control of pullorum disease. Immunologic and serologic studies were continued in the investigation of commercial and experimental whole blood antigens. False agglutinations were sometimes obtained on the blood of birds that yielded a non-pathogenic staphyloccus when the ovaries were cultured. The antigens that gave these false agglutinations were unusually sensitive and were characterized by a high acidity. The antigens studied were found to exhibit wide variations in reaction between pH 4.5 and 7.2. The findings of this investigation are reported in an article appearing in *Veterinary Medicine* XXXV, 9: 511-513, September 1940.

Work is in progress at the present time dealing with the effect of vitamin C on the production of antibodies against *Salmonella pullorum* in chickens. Vitamin C determinations are also being carried out with chickens in high and low production and with those which have contracted various diseases.

A testing school was conducted again this year in which a larger number of field operatives took part than in previous years. Progress in pullorum eradication is evident by the quality of work being done. *(W. V. Halversen, G. C. Holm, C. E. Lampman)*

Paratyphoid in Chinchillas Discovered

During the year an investigation was conducted to determine the cause of losses occurring in a colony of chinchillas. The findings indicated that the disease was a paratyphoid infection. A report of this study is to be found in *Veterinary Medicine* XXXV, 9: 501, September 1940. *(G. C. Holm, W. V. Halversen)*

Clinical and Laboratory Diagnoses Numerous

During the past year, clinical and laboratory diagnoses have been continued as in the past, making it possible to determine the prevalence of various livestock diseases in the State and opening new problems for investigation. A large number of veterinarians and livestock owners have presented material for examination. A total of 1,078 samples were examined during the year. *(Staff)*

Bacteriological Factors Affecting Growth of Alfalfa Studied

The present studies have been carried out both in the greenhouse and in the field for the purpose of determining those factors

which might affect the symbiotic relationship between the alfalfa plant and the nodule bacteria. There is some reason to suspect that the root nodule bacteria in the soil may lose their ability to promote maximum growth of the plant, and in some cases actually become parasitic to the extent that they may depress the growth of the host plant. Another aspect of this problem is indicated in the published studies from Rothamsted Experimental Station at Harpenden, England, where it was reported that boron deficiency resulted in the formation of defective nodules upon horse bean *(Vicia faba)*. These defective nodules did not promote normal growth of the host plant. The present problem resolves itself into two phases: first, are the root nodule bacteria present in the soil efficient in promoting the growth of the alfalfa plant? and second, are there certain mineral deficiencies or is there a lack of certain minor elements in the soil which might affect plant and bacterial relationships so as to prevent the normal benefits usually accompanying the formation of root nodules?

Greenhouse studies have been made upon three Idaho soils which have shown declining alfalfa yields. Salts of aluminum, barium, boron, cobalt, copper, iron, manganese, and zinc were added to the soils in varying concentrations. Inoculated alfalfa seed was then planted in the soil, and the effect of the yield and nodulation of the plants has been studied. During a period of 5 months, only slight differences in growth have been observed. However, it is possible that the second season's growth of the plants will be more striking.

These results have been checked by the simultaneous culture of alfalfa inoculated with root nodule bacteria in a synthetic nitrogen-free nutrient substrate. Effective nodulation of alfalfa is not dependent upon the presence or absence of minor elements to the extent observed at Rothamsted on *Vicia faba*. Observations of field tests will be made next spring, and if differences in growth are observed, nodules will be examined histologically to determine any differences in structure. *(W. V. Halversen, G. O. Baker)*

Biological Test for Minor Elements Studied

Aspergillis niger, a common bread mold, has been found to be extremely sensitive to the absence of certain of the minor elements, especially iron, zinc, and other heavy metals. Experiments have been made to determine the adequacy of the supply of boron, cobalt, iodine, zinc, copper, and manganese in soils which do not grow as large crops of alfalfa as they originally did. These tests were made according to a modified Stienberg technique. A basic nutrient solution containing sugar and basic essential minerals was used as a culture medium to which varying quantities of the minor elements were added in such combinations as to leave out one of the minor elements. Soil was added to the solution and the growth of the fungus was taken as an indication of the ability of the soil to supply the missing element. This technique works very well on solutions without the soil. However, when soil is added to the culture solution, a marked depression in the growth of the *Aspergillis niger* results. This depression is apparently due to the fixation of certain of the

minerals, probably phosphates. Large quantities of soil, in some cases 50 grams of soil per 100 ml. of culture medium, are required to overcome the depressing effect noted with smaller amounts of soil. *(W. V. Halversen)*

Azotobacter Plaque Test for Available Phosphate Evaluated

The Azotobacter plaque test for measuring phosphate deficiency has been used in many laboratories with variable success. In the present studies 38 samples of soil, for which yield data had been secured by the Department of Agronomy, were available to show the responses of alfalfa, potatoes, wheat, and beets. These soils were tested according to a modified Azotobacter plaque test developed in this laboratory. All of these samples except one were deficient in phosphorous according to the plaque test. Seven were only slightly deficient, and the remaining 30 samples were markedly deficient. Crop yield data, however, did not correlate with the plaque test, for six samples actually had lower yields after phosphate treatment, three showed no increase, seven showed fair increase, and only eleven showed marked response. Taking for granted that the crop response to the application of phosphates is a true measure of phosphate deficiency in soil, it would appear that the Azotobacter is too sensitive, because it indicates phosphate deficiency in many soils where crop response would fail to economically justify the application of phosphate fertilizers. *(L. E. Ensminger, W. V. Halversen)*

Agricultural Chemistry

Carbon Dioxide Influences Sorption of Organic Colloids by Clay Minerals

WORK is in progress to determine the type of clay minerals in Idaho soils. Dehydration curves have been run on the colloidal fraction of several Idaho soil series. These curves indicate that the clay fraction of most of these soils is composed primarily of partially weathered primary minerals. The clay deposits in the vicinity of Moscow, which are used for ceramic products, are mostly of the kaolinitic type.

Previous work has shown that organic matter is chemically bound by the inorganic fraction of the soil under acid conditions. Work has been under way the past year to determine the sorption of organic matter under alkaline conditions such as occur in south Idaho. Little or no sorption would be expected in alkaline soils. However, the carbon dioxide produced by roots of living plants and by decomposing organic matter causes localized areas in the soil to become acid. In limited areas surrounding roots and rapidly decomposing organic matter the soil reaction may be changed from alkaline to acid (from pH 8.5 to pH 6.1). At the reaction thus produced, pH 6.1, considerable sorption of organic matter was found to occur. *(L. E. Ensminger)*

Base Exchange Capacity of Idaho Soils Measured

Base exchange capacity is a measure of the capacity of soils to absorb basic nutrients and thus prevent the leaching of these nutrients from the soil. Those absorbed bases are held in the soil in a form available to plants. The base exchange capacity of a soil depends on the amount and type of clay present, and on the amount of humus.

The base exchange capacity of a number of soils has been determined. The capacity of southern Idaho soils ranged from 11 to 38 M. E. per 100 grams of soil. The capacity of northern Idaho soils ranged from 10 to 20 M. E. per 100 grams of soil. These values are similar to those for soils of other agricultural areas. *(L. E. Ensminger)*

Methods for the Preservation of the Carotene Content of Alfalfa Investigated

Loss of vitamin A content of feeds during storage is one of the major problems in the poultry industry. Temperature is one of the chief factors influencing the rate of deterioration of the vitamin A potency in poultry feeds.

Figure 10 shows the influence of the storage temperature upon the keeping qualities of carotene in dehydrated alfalfa during storage for 10 months. It is clearly shown that the carotene content of dehydrated alfalfa is quite stable at 5° F, but at temperatures above this deterioration takes place and increases rapidly with increase of temperature. Alfalfa stored during the hot summer days looses most of its carotene content and becomes valueless as regards vitamin A potency. The best means for the preservation of the carotene content is to keep the forage at the lowest possible temperature. Use of the later cuttings of alfalfa, avoiding storage through the hot summer days, will aid in obtaining a higher carotene content of alfalfa for winter use.

Since it is not always possible or economical to keep hay at low temperature, various methods for preventing or retarding the deterioration of carotene are being investigated. The methods tried include ensiling, pelleting, and use of antioxidants. The results thus far obtained are not conclusive. *(D. W. Bolin, C. E. Lampman)*

Homogenization of Milk Affects the Quality of Cheddar Cheese

In cooperation with the Department of Dairy Husbandry, 36 batches of cheddar cheese were made from raw milk, and three each from milk treated as follows: Raw homogenized milk, pasteurized milk, half raw and half pasteurized milk, pasteurized skim milk and raw homogenized cream, raw skim milk and raw homogenized cream, pasteurized skim milk and pasteurized homogenized cream, and 90 per cent pasteurized milk and 10 per cent raw homogenized milk.

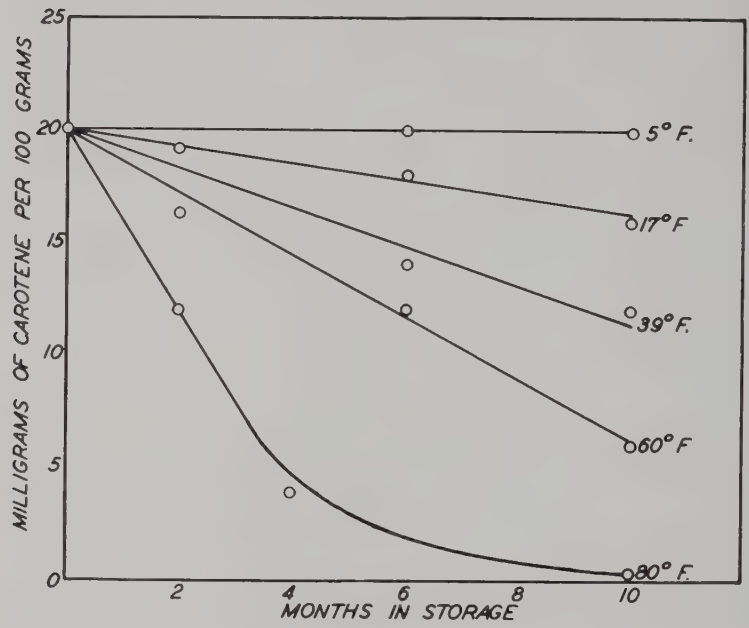

Figure 10.—Influence of the storage temperature upon the carotene content of alfalfa.

Flavor, body, and texture scores and chemical analyses for moisture, fat, insoluble fatty acids, soluble fatty acids, Reichert-Meissl number, Polenske number, pH value, titratable acidity, and saponification number were made at intervals of 3 weeks for a total ripening period of 24 weeks.

The cheese made from raw milk was of uniformly high quality. The cheese made from pasteurized milk was of equally good quality, but seemed to ripen somewhat more slowly. Cheese made from pasteurized homogenized milk was not quite as good as that made from non-homogenized milk but was acceptable. The cheeses made from all other combinations including homogenized cream or milk were rancid, and the rancid flavor persisted throughout the ripening period.

Work is now in progress to determine the cause of the development of rancidity when homogenization is employed, and a means for correcting this condition is being sought. *(R. S. Snyder, H. C. Hansen)*

The Use of Salt for the Preservation of Cream Creates a Problem in the Creamery

It has become rather general practice to add from 5 to 10 per cent of salt (sodum chloride) to sweet cream which is to be stored for a time, or which is to be shipped long distances. This treatment

greatly delays fermentation and is thus desirable, but creates rather a serious problem in the creamery.

When the salted cream is tested by the Babcock method, the sulfuric acid reacts with the sodium chloride to produce hydrochloric acid, and at a concentration which is apt to cause dangerous accumulations in the air of small poorly ventilated laboratories such as are commonly found in creameries.

It is urged that where such conditions exist, suitable ventilation equipment be immediately provided. An exhaust fan, to carry the fumes safely out of the building, should be installed wherever salted cream is to be tested. *(R. S. Snyder, H. C. Hansen)*

Oil Contents of Vegetable Oil Crops Measured

The average oil content of the safflower, grown in cooperation with the Department of Agronomy on the test plots at Caldwell, Aberdeen, and Moscow, was 25.0 per cent. Castor beans were grown on the three test plots, and the average oil content was 48.8 per cent. Measurements of the oil contents of several other oil seeds are now being made and the characteristics of these oils will be determined. *(L. M. Christensen, K. H. Klages)*

Insects

Possible Control Developed for Lygus Insects of Alfalfa

SEVERAL pyrethrum and rotenone-containing dusts, as well as other miscellaneous dusts, were tested in the laboratory to determine their relative effectiveness against Lygus insects. Lygus nymphs were found to be much more resistant than adults to all insecticides tested. A dust prepared from 1 part dry pyrocide and 7 parts talc had approximately the same toxicity to adults as a cube-sulphur dust containing 0.88 per cent rotenone, but was more effective against the nymphs. The addition of 3 per cent pine oil did not increase the toxicity of the cube-sulphur dust. A dust prepared from dry pyrocide, cube and talc, containing 0.25 per cent pyrethrins and 1.00 per cent rotenone was extremely effective against the adults, and was the only dust that gave satisfactory kills of nymphs. Dinitroorthocyclohexylphenol and a Paris green-sulphur dust were relatively ineffective against both adults and nymphs. No significant differences were noted in the resistance of the three species *L. elisus, L. hesperus,* and *L atriflavus* to a pyrocide dust.

Dusting and cultural control projects were conducted this year in Bingham County. Dusts which were applied were made from pyrethrum or rotenone with suitable carriers. Plots were arranged on the Aberdeen farm and most of the alfalfa and clover on the farm was dusted. Dusted fields, in general, had lower populations of Lygus than the undusted check plots, but the populations were not sufficiently reduced to give commercial control of the

insects. Timing of applications as well as method of application should be further studied. Cultural control of Lygus in alfalfa seed fields shows some promise for relief from the attack of this insect. Those fields which were so treated that populations of the insect were reduced produced some seed, while fields not so treated produced no seed. *(W. E. Shull, R. A. Fisher.)*

European Earwig Bait Improved

Experiments have been conducted in an effort to provide a cheaper bait for earwigs than the one in present use. The substitution of sawdust for the bran in the bait was not satisfactory. Laboratory experiments showed that the amount of sodium fluosilicate in the bait could be reduced by one-half and still be effective. These results were confirmed by one application of the diluted bait under practical out-of-doors conditions. *(R. A. Fisher.)*

No New Control for Cabbage Maggot in Radishes

A large number of materials have been tested as possible substitutes for mercuric chloride to control cabbage maggots attacking radishes. Many of these materials proved valueless, either killing the plants or giving no control of the maggots. Materials showing promise of giving control include various rotenone preparations, diphenylamine, cyclohexylamine, and phenothiazine. Until further work is done with these materials, the use of mercuric chloride must continue to be the standard control of this insect pest. *(R. A. Fisher.)*

Onion Thrips Control Studied

A preliminary set of experiments for the control of the onion thrips was conducted during late summer. Plots were replicated four times and the treated plots alternated with the check plots. The treated plots were sprayed with a solution prepared by adding ½ gallon of a special liquid antimony compound, containing an equivalent of approximately 23 per cent Sb_2O_3 by weight, to each 100 gallons of water. To this solution was added 4 pounds of granulated sugar. The plots were sprayed on July 11 and July 18, when the thrips were at their peak of abundance, and at about the time the onions stopped growing. There was no apparent reduction in the thrips population in treated plots after the sprays were applied, and there was no difference in the average yield per plot between the treated and the untreated plots. No critical analysis of the data was made. *(H. C. Manis.)*

Control of Turnip Aphid in Seed Radish Attempted

Experiments were conducted during the summer to attempt to find an insecticide which would give satisfactory control of the turnip aphid in commercial radish seed fields. Plots for the application of five insecticidal dusts and a check plot were selected at random. The dusts used were: (1) Dry Pyrocide—talc (1-5), (2) Dry Pyrocide—talc (1-9), (3) Dry Pyrocide—diatomaceous earth (1-9), (4) Dry Pyrocide—sulphur (1-9), (5) Cubor 100M. The treated plots were dusted on May 29 and June 10. Population counts

were made before and after each application. These experiments were discontinued after the second application because of the natural decrease of the original infestation due to hot, dry weather. Population counts made after the applications showed a reduction in the number of aphid colonies per plot on all plots treated with dusts containing Dry Pyrocide. Plots treated with Cubor 100M showed an increase in the number of aphid colonies per plot. The fact that Cubor 100M killed a number of predators and did not kill the aphids probably accounts for this increase. No critical analysis was made of the data obtained because of the low aphid infestation throughout the growing season. *(H. C. Manis.)*

Tomatoes Grown Free From Beet Leafhopper

The work that was continued to determine the effect of coded materials on the beet leafhopper showed that the material E-85 was no longer effective at dilutions that would not burn the plant tissue.

Tomatoes were successfully grown under aster cloth and individual covers. In the case of individual covers, where the covers were removed one week before the peak movement of the beet leafhopper, the per cent curly top was 40 per cent as compared to 100 per cent for the check. Where the covers were removed 2 weeks following the peak movement of the beet leafhopper, the per cent disease was cut to 30 per cent as compared to 100 per cent for the check. The healthy plants produced an abundance of smooth clean fruit. This project is in cooperation with the State of Idaho and Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture. *(W. E. Shull, E. L. Turner.)*

Potato Insect Survey Conducted

A complete potato insect survey was carried on in the Burley-Declo area and extended throughout the potato growing sections from Pocatello to St. Anthony. There were no tomato psyllids and no Colorado potato beetle found in any of the collections. The main species of insects occurring on potatoes in the order of their abundance are: (1) Western potato leafhopper, (2) Western potato flea-beetle, (3) Lygus, (4) Beet leafhopper, and (5) False chinch bug. Field observations and laboratory experiments indicate that the potato leafhopper was responsible for a white stippled appearance of the lower leaves, and not the browning and curling that accompanies "early maturity." Control methods consisted of both dusting and spraying, and there was no appreciable reduction in leafhopper populations from either method. Life history studies showed the incubation period to be an average of 12 days, length of time between instars 2 to 5 days, with an average total of 13.9 days from hatching to the adults. *(W. E. Shull, E. L. Turner.)*

Alfalfa and Clover Insect Survey Completed

A survey of the alfalfa and clover fields of the state produced no new pests of these crops. A complete collection of all insects found on alfalfa and clover was made. These materials will be prepared for classification at a later date. *(W. E. Shull.)*

Blood Physiology Studies Continued

The studies of the blood physiology of insects was continued, the pea weevil being used as the experimental animal. A method was found for isolation and study of blood cells in a small insect like the pea weevil, and it was determined that all the cells of the blood of the pea weevil were similar except for size. It was also determined that blood coagulation in the adult pea weevil was a plasma phenomenon. *(W. E. Shull.)*

Pea Weevil Control

The cooperative project on pea weevil control was continued with the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture.

Rotenone, as a pea weevil control material, was demonstrated under field conditions and on a large scale during 1939 and 1940. This material had already been used successfully for canning peas where the value of the crop was relatively high, but had not been extensively used in the control of weevil in seed peas. During 1939, a control of 54 per cent of the weevil in all of the peas of the territory was obtained. In fields where proper dusting was done, very excellent control was obtained.

Dusting was generally adopted during the 1940 crop season with results exceeding those achieved during 1939. Approximately 350 tons of dust containing 1 per cent rotenone were used in the Palouse area this year for weevil control. *(W. E. Shull, T. A. Brindley.)*

Cultural Control of Wireworms by Crop Rotations Possible

The cooperative project on the cultural control of wireworms was continued this season with the Bureau of Entomology and Plant Quarantine (U.S.D.A.). Large field plots (16) near Parma, Idaho, organized in 1937 to study the effect of various crop rotations on wireworm numbers and damage, have been checked over during the season. Wireworm infestations in the alfalfa plots have shown a decline of nearly 50 per cent in the last three seasons. Plots planted to row crops the last three seasons have not shown any large increases in wireworm numbers. Wireworm damage to potatoes in these plots has been negligible where the wireworms were no more numerous than about one per square foot. Forty additional fields in the Boise Valley that have been in alfalfa for several years, and plowed this year to go into other crops, were sampled for wireworms. These will be rechecked for several years to find the effect on wireworm numbers of various crops planted in these fields. The effect of various crops as food on the growth and life cycle of wireworms *(Limonius californicus* Mann.) is being studied under controlled conditions in soil cages at Parma. Where the sequence of crops was potatoes (1938), sugar beets (1939), and wheat (1940), only a few wireworms matured to the adult stage in the third summer, the majority continuing as wireworms to make a minimum of

4 years in the life cycle. No adult wireworms appeared in cages where 3 years of continuous wheat was maintained and only one adult was produced after three seasons of alfalfa. Alfalfa proved to be the poorest food plant in relation to growth and survival of wireworms, with corn and potatoes showing fairly normal growth. *(W. E. Shull, F. H. Shirk.)*

Squash Bug Control Now Possible

Three sets of experiments were conducted during the summer to attempt to find a practical control for the squash bug on curcurbits.

Set 1. To determine the number of applications of a Dry Pyrcide-talc dust, containing 15 per cent Dry Pyrocide, necessary for the control of the squash bug. Data indicates that three to four applications of the dust at 10-day intervals are sufficient to control both nymphs and adults, provided the first application is made within a week or ten days after the first overwintering adults appear in the field.

Set 2. To determine the value of various insecticides and insecticidal carriers in the control of the squash bug. Three dusts and one spray containing pyrethrum gave good control of the squash bug. The spray was somewhat less effective than were the dusts. Talc proved to be the best carrier, while sulphur caused considerable burning of the squash vines. A Cubor dust controlled the nymphs but was ineffective against the adults.

Set 3. Preliminary tests were made with two new insecticides. One, a spray containing rotenone extract was ineffective against both adults and nymphs. The second, a walnut shell flour dust containing 1 per cent dinitroorthocyclohexylphenol effectively controlled both the nymphs and adults, but severely burned the squash foliage. *(H. C. Manis.)*

Plant Diseases

Experimental Program with Potato Ring Rot Disease Inaugurated

THE efficiency of several toxic materials in preventing the spread of *Phytomonas sepidonicum* (Spieckermann) S.A.B., the causal organism of ring rot of potatoes, was studied. The potato seed pieces were dipped in the various solutions after having been cut with a knife previously passed through an infected tuber. The dips were made from acid mercuric chloride, New Improved Semesan Bel, copper sulphate, zinc sulphate, yellow copper oxide, potassium permanganate, iodine, and brilliant green. None of these materials were effective in preventing infection of the cut seed piece by the organism carried on the cutting knife. Acid mercury, however, does show some promise as is indicated in Table 14.

Table 14.—Effectiveness of acid mercury treatment in controlling spread of ring rot organism by the cutting knife

Variety	Number of pieces planted	Whole Seed		Inoculated cut seed			
		Check		Check		Acid mercury treated after cutting	
		Stand	Infection[1]	Stand	Infection	Stand	Infection
Netted Gems	150	100	0	98.7	91.2	87.3	47.3
Ida. Rural	150	100	0.6	94.0	78.7	81.3	13.9
White Rose	150	88.6	7.4	80.6	31.9	80.6	7.4

[1] Per cent stand and infection

Preliminary tests indicate that the organism is not spread by irrigation nor does it survive in soil that previously produced an infected crop. *(J. M. Raeder, Edward M. Graves, John L. Toevs.)*

Breeding for Resistance to Potato Virus Diseases Continued

Detailed observations were made on 754 seedlings, 387 of which were retained for further observations. Of the 387, 254 are of Katahdin parentage, 2 are crosses of Bliss Triumph by Katahdin, and 4 of the Russet Rural by Katahdin. Among the seedlings of Katahdin parentage are 10 that have been under observation for 5 years and 4 that have been under observation for 4 years. In addition to the above, an additional 222 seedlings were grown for the first time this year.

These seedlings are being observed for their response to virus infection. *(J. M. Raeder.)*

Disease Resistant Varieties of Beans Developed

Five bean experiment plots were again established in southern Idaho and were located near Twin Falls, Buhl, Hazelton, Jerome, and Gooding. The reactions of many hybrid selections of field and garden beans to our most important bean diseases were studied and recorded. Common bean mosaic was present on susceptible selections on all plots and curly top was severe on the Buhl experiment plot giving a very satisfactory test to the resistant selections.

Great Northern U. I. 15, a new Great Northern selection resistant to the the viruses of curly top and common bean mosaic, was increased on the plots and on three seed farms in three different counties. No curly top or common bean mosaic was reported in the variety, and good yields were obtained on the seed farms. On the experiment plots, Great Northern U. I. 15 gave greater yields than did commercial Great Northern selections under curly top conditions. Seed of this selection will now be available through the county agricultural extension agents to a larger number of growers, and may be of special value when grown in areas where curly top has been very severe in the past on Great Northern beans.

Additional crosses of commercially important garden beans on resistant selections were made in the greenhouse and tested this season in the field. Of the garden beans, the refugee type wax and green podded selections have shown complete resistance to curly top and common bean mosaic and will be subjected to additional tests. Several hundred promising selections of various types have been grown in the greenhouse each winter, and all selections were inoculated with the virus of common bean mosaic. Pinto selections of desirable seed and vine types have been developed which are resistant to common bean mosaic and curly top viruses. Work is also in progress with other field and garden bean varieties. This project is in cooperation with the State of Idaho and the Bureaus of Plant Industry and Entomology and Plant Quarantine of the U. S. Department of Agriculture.

The principal bean variety grown in northern Idaho on a commercial basis is the small flat white. This bean is susceptible to mosaic and is a mixture of several types of white beans. Numerous field selections have been made in order to obtain a desirable type. Four were found to be quite satisfactory in this respect. Certain of these have been crossed with the variety Norida, a mosaic-resistant white bean, in an attempt to develop a mosaic-resistant small flat white bean. *(Donald M. Murphy, W. J. Virgin.)*

Pea Diseases Studied

Pea disease investigations have dealt mainly with the near-wilt disease and poor germination in peas. Through the cooperation of J. C. Walker of the University of Wisconsin, several selections from a Wisconsin Perfection, Roger K Cross were tested for their reaction to near-wilt on a naturally infested field in Wisconsin. Some of the selections exhibited considerably more resistance than their susceptible parent, Wisconsin Perfection; one of these selections was superior to the others for type.

Invariably, certain seed lots of peas will be found that are low in germination which cannot be accounted for by injured or immature seeds. The seed is of normal appearance, yet fails to germinate. It has been found that bacteria are usually associated with these non-germinating seeds. Investigations are under way to determine what role these bacteria play in regard to the germination of pea seed. *(W. J. Virgin.)*

Wild Tomato Resistant to Curly Top Virus

Studies have shown that *Lycopersicon chilense* is apparently resistant to the curly top virus. Progenies from back crosses of tomato on the hybrid tomato x *Lycopersicon chilense* were grown at Buhl, Idaho, where they were subjected to the disease. Certain of the progenies did not become diseased with curly top. These are being used in further breeding work. *(W. J. Virgin.)*

Storage Disease of Carrots Serious

Carrot seed is produced on a large scale in Canyon County. Since it requires two growing seasons to produce a crop of seed, a storage period of about 4 months through the winter is common practice. During this storage period, rots develop, caused mainly by two fungi, *Sclerotinia* and *Botrytis sp.* Severe losses have occurred at times; consequently, a project has been set to develop a control for these storage rots. Different fungicides are being used to treat the carrot roots prior to storage. *(W. J. Virgin.)*

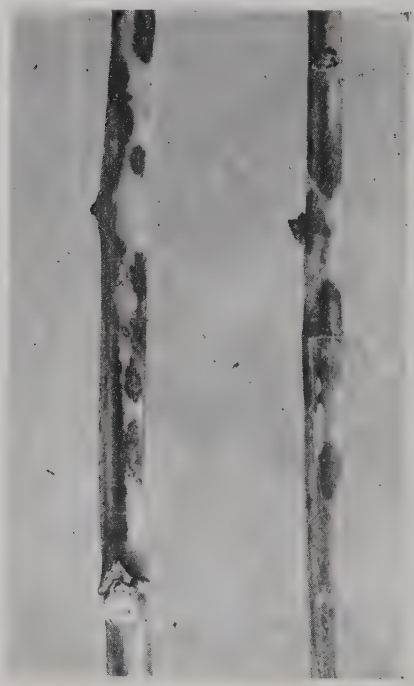

Figure 11.—Canker and dieback of thornless youngberry canes caused by *Septoria sp.*

Fruit Disease Investigations Continued

A canker and dieback disease of youngberry, boysenberry, and several varieties of blackberries has become very serious generally in plantings throughout the State. Symptoms consist of reddish brown areas, frequently around the buds and upon extensive development of the diseased area, girdling of the cane occurs with subsequent cane killing. Isolations and inoculations have shown that some of the injury is caused by a fungus *(Septoria sp.)*. Another fungus *Glomerella cingulata,* (recognized as an occasional parasite on brambles) was identified on infected canes send to the Division of Mycology and Disease Survey, U. S. Department of Agriculture. Seasonal weather conditions undoubtedly play an important part in development of these fungi, and preliminary spraying tests failed to give satisfactory control. *(See Figure 11.)*

In attempts to identify and study various diseases of tree fruits, a great many tests were made by budding, grafting, and inarching diseased wood to healthy trees. The cherry mottle leaf complex, peach wart, and other suspected virus diseases of peach, prune, and nectarine were involved. Many orchard surveys were made and several plantings mapped in detail. A "rough bark" condition of

peach is being studied. The leaf spot of Italian prune developed severely on shoots from diseased buds, but the rest of the tree foliage was normal two seasons after budding.

An apparently new disease of peach fruit has been named rusty spot. Discolored spots appear on the fruit, finally leaving a discolored, fuzzless area which disfigures the fruit.

Further inoculation tests with *Coryneum beijerinckii* Oud., causing Coryneum blight of stone fruits were made using the fungus from peach, apricot, cherry, prune, pin cherry, and almond. All isolates produced abundant infection on Bing cherry, Slappy peach, and Moorpark apricot.

Results of tests in cooperation with the Department of Agronomy the past 2 years on the control of drought spot and corky core of apple have shown that these diseases are controlled by the use of borax. Recommendations have been published as Mimeo-Leaflet No. 46 of the Idaho Agricultural Experiment Station. *(E. C. Blodgett.)*

Nutrition

Ascorbic Acid Metabolism Studies of College Men Continued

IN recent years increasing emphasis has been placed on nutrition status studies in research laboratories. By such studies investigators attempt to determine the nutritional condition of a given group of people in regard to some nutrition factor.

This department has one such project under way as a study of the ascorbic acid (vitamin C) metabolism of college students in which an attempt is made to determine the adequacy of the supply of vitamin C of Idaho college men.

Under this project a total of 36 tests on 26 different men have been carried out. A few of the men have been subjects several times.

This last year four men took the test in late October and early November and again in February. Of these four only one gave as good a response in mid-winter as he had in the fall. It seems probable that the intake of Vitamin C containing foods by the other three had been too low during the interval.

This year's work has included an examination of the blood of several students for ascorbic acid. This is done by taking a few drops of blood from the finger or ear of the subject, separating out the plasma and titrating a definite amount of the plasma with a special dye (2-6 dichlorophenolindophenol). From the values obtained the ascorbic acid present in 100 ml. of the blood plasma may be calculated.

Using this procedure and following the blood values every hour after a large dose of vitamin C had been given, it was found that the ascorbic acid in the blood increased for the first 3 or 4 hours and then decreased gradually until the amount was approximately the same as before the dose had been given.

When blood values and urine values were both studied for the

same man, any considerably increased excretion occurred only after the blood value rose to one milligram or more per 100 ml. of blood plasma. This agrees with reports from other laboratories.

The ascorbic acid metabolism study is a cooperative one among the Home Economics Departments in the Agricultural Experiment Stations in five northwestern states and will be continued. *(Ella Woods.)*

Vitamin B-Complex Factors in Russet Burbank Potatoes

Several years ago, before the vitamin B-complex was fully understood, a project was undertaken to analyze the Russet Burbank potato for vitamin G. Since the beginning of this study, other laboratories have shown that what was once called vitamin G is really several factors, and the potato investigation has followed these developments.

In the course of the studies a synthetic diet has been evolved which, over a limited period at least, gives normal growth in young rats when supplemented with the pure synthetic chemicals that are known to make up the B-complex.

Using this basal diet for biological analyses of the potato, it has been shown that the potato contains thiamin, pyridoxine, choline, and pantothenic acid.

Because of the generous cooperation of the Department of Chemistry of the University of Idaho, the chemical analyses for the water soluble factors of the potato soon will be available for comparison with these biological analyses.

Another approach to the same problem was made this year by using potato meal as the main ingredient and the sole source of the vitamin B-complex in a diet for young rats. This meal, making up 76 per cent of the diet, was supplemented with vitamin-free casein, calcium carbonate, sodium chloride, fat, and fat soluble factors. On this diet rats grew steadily for 3 months at a rate approximately one half that of rats receiving Purina Chow.

On the basis of all these experiments, it seems fair to conclude that the Idaho potato contains in limited amounts at least all of the factors of the vitamin B-complex, or substances which can be converted into them in the animal body. In planning for these important nutritive factors in the diet, the potato should be given consideration as a valuable source. *(Ella Woods.)*

Vitamin A Value of Ladino Clover Studied

Several years ago the Idaho Agricultural Experiment Station studied various grasses and legumes as to growth habits, yield, palatability, and chemical composition in an effort to formulate desirable pasture mixtures for dairy cattle. With these special plots available as sources of material, a study by the biological method of pasture plants as sources of vitamin A was undertaken with the cooperation of the Department of Dairy Husbandry.

In the earlier studies no direct comparisons can be made with carotene or reference oil, for they were not available at the time the plants were fed. However, some of the plants studied more recently have been controlled by littermate feeding of U.S.P. reference cod-liver oil and carotene determinations on samples of the plants assayed biologically have been made by the Department of Agricultural Chemistry.

This year, tests on Ladino clover were repeated and they compare favorably with those obtained last year but are still somewhat above the value indicated by the carotene content as determined chemically.

All the plants studied proved to be excellent precursors of vitamin A and from the results of the bioassay would be ranked in the following order: First-year sweet clover, smooth brome, red top, orchard grass, alfalfa, meadow fescue, second-year sweet clover, white clover, timothy, Kentucky blue grass, Ladino clover.

Because of the large amount of pasture consumed by the cow, any of these grasses or any combination of them should assure an ample supply of carotene to maintain a high value of vitamin A in the milk. *(Ella Woods, D. R. Theophilus.)*

A Study of the Biological Value of the Protein of Mature Peas Begun

A project for the study of the biological value of the protein of whole peas was started about three years ago in cooperation with the Department of Animal Husbandry, but was temporarily discontinued because of the difficulty of supplying the members of the vitamin B-complex to the diet without including small amounts of amino acids with the extracts fed. This year the members of the B-complex are available as pure synthetic products and the investigation was reopened. *(Ella Woods, W. M. Beeson.)*

Utilization of Agricultural By-Products

Yields of Alcohol and By-Products Improved

DURING the past 8 years, research looking toward improvement in the economy of the production of industrial alcohol from starchy farm crops, such as potatoes, wheat, barley, corn, and grain sorghums, has been in progress. In the past year marked progress has been made and the results will be described in a bulletin now being prepared.

Using a new saccharifying agent and an improved cooking process, yields of both alcohol and by-products have been improved, and at the same time conversion costs have been reduced. The new saccharifying agent is produced by growing a selected strain of the fungus *Aspergillus oryzae* on treated wheat bran under carefully controlled conditions. This is added to a mash made from the starchy raw material by cooking and cooling by the new procedure.

The mold bran must be used in accurately controlled amounts varying from 3 to 7 per cent of the starch content of the mash, the exact amount used depending upon the kind of starch present and other factors. The temperature and duration of the saccharification operation also must be carefully selected. With some raw materials small amounts of added nutrients are needed.

The yields from several raw materials by the old and new processes are shown in Table 15. It will be noted that in the old process there is a large loss of raw material during processing. Preliminary data indicate that this loss results from the production of acids during fermentation which decompose to carbon dioxide and water during the distillation and in drying the residual solids. With the new process, losses are greatly reduced due to improved yields of both alcohol and by-product feed. The quality of the by-product feed has also been improved.

Table 15.—Comparison of alcohol and by-product feed yields by old and new processes

Raw Material	Old Process			New Process		
	Anhydrous alcohol per cent of total dry matter	Dry residual solids per cent of total dry matter	Loss in process per cent of total dry matter	Anhydrous alcohol per cent of total dry matter	Dry residual solids per cent of total dry matter	Loss in process per cent of total dry matter
Cull white potatoes	25.6	41.0	13.9	34.0	39.4	0.6
Average quality grain sorghums	30.5	29.8	16.5	33.8	38.4	2.0
High quality corn	34.2	28.0	11.8	37.6	32.4	1.3
Average quality corn	31.0	29.7	15.7	33.6	39.2	1.6
Low quality corn	29.6	32.0	15.9	31.9	40.4	3.4

New Plant Equipment Installed

Through the cooperation of the Idaho Advertising Commission, several changes were made during the year in the plant at Idaho Falls *(See Figure 12)*. These include the construction of a storage shed for the alcohol, improved facilities for handling the cull potatoes, storage tanks for cooling water and beet molasses, a mold bran unit, and a mash cooler and conveyor which reduced the time of processing by about 3 hours. A large amount of time and expense were required to establish the details of the equipment needed to employ the improved operating techniques developed in the laboratory. The present equipment is not ideally suited to this new operation but has served to confirm the laboratory data. Plans for the changes needed to equip the plant for the new operation have been developed.

Markets for Alcohol Investigated

The project has been hampered by the lack of means for sales development, and the volume of alcohol sold has been less than the maximum productive capacity of the plant. Thinner for traffic line lacquer was sold to the State Bureau of Highways, using a specially

Figure 12.—Unloading potatoes at the Idaho Falls alcohol plant. Cull potatoes are unloaded directly into the storage cellar bins.

denatured alcohol, Formula 1. Alcohol for blending with gasoline for motor fuel was produced and sold through local oil companies and to the Idaho Falls Potato Growers, Incorporated, and the Upper Snake River Valley Dairymen's Association, for use in their truck fleets. Closer cooperation between the local potato growers and fuel users was sought. The sale of alcohol for antifreeze, which was manufactured from completely denatured alcohol, Formula 14, by the addition of rust inhibitors and an evaporation retarder, was one of the chief outlets for the potato alcohol. A study was made of the possibility of supplying potato alcohol for car heater fuel for the Pacific Fruit Express Company.

During 1940, a total of 241.4 tons of cull potatoes were processed, yielding 4,130.4 gallons of alcohol. This brings the total amount of cull potatoes used by the plant during the 2 years of operation to 786.9 tons, with a total production of 12,091.7 gallons of alcohol.

One of the problems in the industrial utilization of cull potatoes is the provision of raw materials during the approximately 3 months when potatoes are not available. Since beet molasses is also produced in the Idaho Falls area and can be available during the summer months, several fermentations were made with this material, through the cooperation of the Utah-Idaho Sugar Company. Calculated to a basis of 55 per cent total sugar content the yield of anhydrous alcohol was 38.4 gallons per 100 gallons of molasses, or

68 gallons per ton. It was necessary to use added nutrients. Several interesting possibilities of combining potato and molasses fermentations were studied.

Plans for Future Activities Outlined

With the completion of the research on the production phase, emphasis has been shifted to improvements in the economy of utilization of the alcohol and by-products. Thus far it has been indicated that use in motor fuel provides the largest potential outlet for the alcohol. The sound development of this market and of other uses is the principal objective in the present program. In this connection it is also desirable to improve the income from by-products. There is a question whether the residual solids, containing all of the minerals and proteins of the potatoes, should be used as a feed for livestock, as is done in Europe, or be returned directly to the soil. Preliminary calculations indicate that this residue should be of considerable interest as a fertilizer because of its content of organic and other readily available forms of phosphate and of other valuable plant nutrients. *(Marvin Aslett, Hobart Beresford, L. M. Christensen, Eugene Graham, Gerwin Taylor.)*

Aberdeen Branch Station

JOHN L. TOEVS, *in charge*

Potato Research Emphasized

POTATO work was materially increased during 1940, featuring especially the bacterial ring rot disease. The potential seriousness of this disease has been recognized by research workers and leaders in the potato industry, and plans for intensive study have been formulated.

All lots of seed entered for certification in 1940 were tested on the Branch Station. These tests included 156 Netted Gems, 34 Bliss Triumphs, 9 Idaho Rurals, 7 Katahdins, 3 Early Ohio, 3 Irish Cobbler, 4 White Rose, and 1 Chippewa. Tests were conducted in a manner similar to the work conducted for several years at Lewiston except that the plots were larger. A special attempt was made to detect bacterial ring rot when present. Records were kept also on yield and quality. The yield for all Certified Gem plots averaged nearly 10 sacks (100 lb. per sack) more than the check plots planted from station seed one year out of certification.

The Department of Plant Pathology cooperated in this bacterial ring rot study. The results of this experiment may be summarized as follows: A high degree of transmission was obtained from diseased tubers to healthy cut pieces with both Idaho Rural and Netted Gem potatoes—Rurals 79 per cent and Gems 91 per cent, while transmission of the disease was much lower to whole sets—10 per cent for Rurals and 52 per cent for Gems. None of

Figure 13.—A spraying test—attempting control of the Western potato leafhopper, *Empoasca filamenta.*

the treatments used after inoculation proved satisfactory. Best control was obtained from the acid mercury treatment, giving 86.1 per cent control with Rurals as compared to inoculated check, and 52.7 per cent control with Gems. The acid mercury treatment reduced the stand somewhat. New Improved Semesan Bel averaged only 37.6 per cent effective for both varieties. Other treatments proved even less effective or desirable when both control and the effect on stand are considered. Little difference was noted in susceptibility of varieties to infection. Very few plants were obtained from diseased tubers. Tubers that carried the disease in most cases did not germinate. Symptoms of bacterial ring rot appeared from one to two weeks earlier in the Rurals than in the Gems. Results indicate that this disease does not carry over in the soil through the winter.

Potatoes Give Best Response to Nitrogen Fertilizers

The value of manure in the production of potatoes again was demonstrated in 1940. The land used for this experiment was plowed out of red clover, but the humus content of soil was quite low. An average of approximately 18 tons of manure per acre was applied early in the spring. The non-manured plots made an average total yield of 278 sacks with 80.5 per cent or 224 sacks of No. 1's. The manured plots made an average total yield of 361 sacks with 78.9 per cent or 285 sacks of No. 1's. The difference in yield was 61 sacks No. 1's, or 27 per cent.

A number of commercial fertilizers were also used in this experiment. Nitrogen was used alone and in combination with phosphate and also in combination with phosphate, potash, and sulfur.

The results obtained indicate that it is the nitrogen that is giving the most response. Increases in yield correspond very closely to the amount of nitrogen applied, regardless of other fertilizer elements.

New Varieties of Potatoes Show Promise

In the potato variety test, the Pontiac variety made the highest yield. The tubers of this variety are very similar to the Bliss Triumph, but the vine growth is much heavier. Two of the round white varieties, Houma and Sebago, and two selection numbers, 181-14 and 46988, show promise of being competitors to the Idaho Rural. The Netted Gem still has no competitor.

Additional work with potatoes consisted of potato seed treatment for control of scab and rhizoctonia, testing different storing conditions previous to planting, and delayed planting of cut seed. Spraying potatoes with two applications each of Bordeaux mixture (dry mix) and lime sulfur failed to reduce leafhopper populations. Counts were higher on the sprayed plots than on those unsprayed because of the greener foliage produced following spraying.

Additional Funds for Potato Research Requested

With the limited funds available for the Aberdeen Branch Station, it has been possible to use very limited amounts for potato research. In order to finance more adequately the projects already under way, and to start other much needed investigation, a request was made for $20,000 additional funds to be used for potato research during 1941 and 1942 at the Aberdeen Branch Station.

Grass Nursery Attracts Considerable Attention

The cooperative project with the Soil Conservation Service of the U. S. Department of Agriculture, started in 1939, deals with the testing of grasses under irrigation and dryland conditions.

Beardless wheatgrass, big bluegrass, sheep fescue, Indian ricegrass, and a number of others, gave seed yields that compared favorably with some of the standard grasses, such as smooth brome, meadow fescue, crested wheatgrass and slender wheatgrass. With the increasing demand for better adapted grasses and the present trend towards increased livestock production, the production of seed may become of economic importance in this State.

Forty acres of desert land on the Aberdeen airport have been fenced, and about 8 acres are used each year for testing various cultural practices, with a number of species of grasses seeded singly and in various combinations. Cultural practices consist of spring and fall seeding on summer-fallow with single, double, deep-furrow drill seedings in fall, and deep furrow and press drill in spring. Similar seedings are also made on ground worked with a duck foot cultivator and on ground with no cultivation.

Practices that Show up Favorably to Date

Fall seeding with double disk drill on summer-fallow and spring seeding on summer-fallow with press drill (beet-drill) appear to give satisfactory results.

The following grasses were used: crested wheatgrass, creeping wheatgrass, big bluegrass, bearded wheatgrass, Michel's grass, western wheatgrass, bulbous bluegrass, longheaded wheatgrass, Indian ricegrass, and needlegrass. The latter two were seeded only in combination. Bearded wheatgrass, crested wheatgrass and longheaded wheatgrass ranked in order named for single specie plantings. Bearded wheatgrass and creeping wheatgrass gave promise as a mixture. Michel's grass made the most vigorous growth and gave the best weed control. Whether or not Michel's grass will behave as a perennial under the conditions of this experiment remains to be seen.

Cereal Work Continues on Large Scale

Cereal work under the direction of the Office of Cereal Crops and Diseases, U. S. Department of Agriculture, was continued with only a few minor changes. The smut nursery was increased to 1000 rows and consisted of strain testing, competition and association studies of smuts.

A preliminary test was conducted with about a dozen of early maturing sorghums (grain and dual purpose sorghums). Weather conditions proved favorable for the following grain varieties: North Dakota Amber produced 2,322 pounds; Sooner, 2,540 pounds; Kalo, 3,451; and Weskan, 3,508 pounds per acre. Plans are under way to enlarge this work next year.

About 75 per cent of the oat work was of national nature, embracing classification, viability, gentic, rust, and smut studies.

Barley work is in the direction of securing high-yielding, smut-resistant types with better straw.

Lemhi wheat, released several years ago, is giving general satisfaction. Efforts are directed towards further improving this wheat by making numerous head selections and keeping each selection under close observation for two years. Two hundred fifty rows of barley and wheat were used for cytological studies. This work was conducted by Dr. Luther Smith of the Cereal Office.

Field Dusting of Lygus Tried

Experiments with *Lygus* dusting on alfalfa seed plots were conducted by the Department of Entomology. At the peak of populations, the *Lygus* count reached 550 insects per 25 sweeps. The dusting of the plots at this time did not greatly lower the *Lygus* population.

Fertilizer Values Indicated

Under the conditions found on the Aberdeen Branch Experiment Station, and when the increased yields for 2 years are considered, the heavier applications of treble superphosphate produced the greatest return above the total fertilizer cost. This is shown in Table No. 16. In calculating these data, the treble superphosphate was figured at $2.55 per hundred or $51.00 per ton; rent for the broadcast spreader, $0.10; and labor cost for making the application, $1.40 per acre. About the only additional expense in harvesting the higher yielding areas would be in stacking the hay, as the other operation expenses would remain approximately the same.

Table 16.—Higher rates of application of treble superphosphate prove economical under certain conditions

Treatment[1]	Yield		Yield	Increase	Returns for each fertilizer dollar	Profit over total fertilizer cost
	1939 tons	1940 tons	2 years tons	2 years tons		
Check	2.13	2.32	4.45			
75 lb. TSP	2.87	4.03	6.90	2.45	$8.98	$14.74
125 lb. TSP	2.96	4.06	7.02	2.57	5.64	14.30
200 lb. TSP	3.68	5.15	8.83	4.38	6.01	25.16
300 lb. TSP	3.54	6.11	9.65	5.20	4.76	28.25

[1] Only one application for each rate was made early in spring of 1939.

The 75-pound application produced the highest, $8.98, and the 300-pound application produced the lowest, $4.76, return per dollar invested in phosphate fertilizer. If, however, the value of the land, taxes, etc., are considered, it seems desirable to obtain as great a return as possible per acre. Thus, when the increased value of alfalfa above the total fertilizer cost is considered, it is observed that the 300-pound application shows an increase of $28.25 per acre and the 75-pound application only $14.74 per acre.

Utilization of Alkali Weed, Bassia hyssopifolia, Reported

An area of 29 acres of alkali land near the Branch Station farm has been used during the summer months for sheep pasture. Three-fourths of the 29 acres is very high in alkali and produces a good growth of an alkali weed, *Bassia hyssopifolia*. The other fourth is composed of some low land which is too wet for the alkali weed.

Bassia hyssopifolia is an annual and grows as high as 6 feet or more, depending on density of stand, moisture, and soil conditions. It branches profusely and the foliage when young is gray-green and quite pubescent. This plant produces seed abundantly. The seed has five hooked appendages and when mature clings readily to animals and clothing, which probably accounts for its rapid distribution. When pastured, the plants resume growth at the axes of leaves and stems, and have the ability to set seed no matter how closely pastured. Sheep will eat the fine stems and leaves, leaving short forked stems of the plant from which new growth resumes.

Figure 14.—(Left) *Bassia hyssopifolia* heavily pastured with sheep during the months of June, July, and August. (Right) *Bassia hyssopifolia* grows to a height of 4 to 6 feet under favorable conditions. This picture was taken across the fence from the pastured field shown in the other view.

This weed makes most of its growth during hot weather. Very little growth takes place until late June or early July.

Approximately 12,000 sheep days of pasture were furnished by the 29-acre pasture, or slightly over 400 sheep days per acre for the season, making approximately 80 to 85 animal units per acre. The feed is palatable and nutritious. The sheep more than maintain their body weight.

Beet Syrup Proves Valuable in Production of Spring Lambs

Beet syrup used in combination with barley for lambs fed in creeps gave very satisfactory results. The syrup was mixed with whole barley at the time of feeding.

Lambs fed barley consumed 0.38 pound daily. Lambs fed barley and syrup consumed 0.38 pound barley and 0.17 pound syrup. Lambs fed oats consumed 0.45 pound and lambs fed (commercial) creep feed consumed 0.75 pound daily. Daily gains were as follows: barley lot 0.590 pound; barley-syrup lot 0.621 pound; oat lot 0.605 pound; and creep feed lot 0.686 pound. The cost of gain was in favor of the two lots receiving oats, and barley and syrup.

Caldwell Branch Station

R. F. JOHNSON, *in charge*

Comparative Value of Corn Silage, Beet Top Silage and Wet Beet Pulp for Fattening Calves Tested

THE inclusion of a succulent feed such as silage or wet beet pulp in a ration of alfalfa and grain for fattening steers has been recognized as a valuable asset in improving the nutritive and physical quality of the ration and eliminating digestive disturbances that may occur. The extent that such feeds, usually of a bulky nature, may be used in a ration depends upon such factors as availability of the feed, length of the feeding period, and the size of the cattle that are to be fed. The comparative value of beet top silage and wet beet pulp, both of which are products of the sugar beet industry, and corn silage was the object of an experiment in which these feeds were used in conjunction with ground barley and chopped alfalfa and fed to 488-pound Angus steer calves for 220 days. On the basis of the dry weight, 5 pounds of beet top silage, 6 pounds of corn silage, and 14.5 pounds of wet beet pulp were fed daily to each calf where these feeds were used. Each calf consumed an average of 9.3 pounds of ground barley per day. The pulp-fed calves consumed 6.4 pounds of alfalfa per day and gained 1.95 pounds per head. The corn silage-fed calves consumed 2 pounds less of alfalfa per day and made similar gains. The calves fed beet top silage ate 2.6 pounds less of alfalfa and gained 1.85 pounds per day. The results of this experiment show that for fattening calves, corn silage and wet beet pulp were equal, and each slightly superior to beet top silage.

The Comparative Value of Corn Silage, Beet Top Silage and Wet Beet Pulp for Fattening Lambs Tested

Corn silage, beet top silage, and wet beet pulp were fed with a basal ration of alfalfa and barley to 70-pound range lambs that were pastured for 45 days on alfalfa and grain stubble before going into the feed lot. The basal ration consisted of 1.2 pounds of barley and 1.5 to 1.8 pounds of alfalfa hay. The silages and the wet beet pulp were fed on the basis of the dry matter content at the rate of 1 pound of beet top silage, 1.5 pounds of corn silage, and 3.8 pounds of wet beet pulp per lamb daily where these feeds were given. Wet beet pulp increased the daily gains 0.04 pound per lamb. In feed requirements for the gains made, 1 ton of wet beet pulp replaced 276 pounds of alfalfa and 63 pounds of barley, and had a value of $1.77 per ton when alfalfa was worth $8.00 per ton and barley was worth $1.10 per hundredweight. The substitution of 0.10 pound of cottonseed meal for barley in the ration with hay and wet beet pulp did not increase the efficiency of the ration. Beet top silage produced negative results from the standpoint of rapidity and economy of gains. The addition of corn silage to the ration did not produce

faster gains, but 1 ton had a replacement value of $2.49. The value of these succulent feeds appears to be limited to the extent to which they may replace the barley and the alfalfa for fattening lambs.

Alfalfa Alone and with Grain Tested for Wintering Stock Calves

Two pens each with thirteen 353-pound Angus stocker calves were wintered on rations of 14 pounds of chopped alfalfa alone and 12 pounds of chopped alfalfa with 2.3 pounds of ground barley. When turned to pasture at the end of a 103-day wintering period, the hay and grain wintered calves had gained 2.15 pounds per head daily and were 18 pounds per head heavier than the calves wintered on hay only, which gained 1.98 pounds per head each day. With hay charged at the rate of $8.00 per ton and grain at the rate of $1.10 per hundred, the feed cost of the winter gains were $3.58 per hundred when grain was fed with hay and $2.90 per hundred when hay was fed alone. After a pasturing period of 144 days on mixed grass and clover irrigated pastures without supplementary feed, the difference in weight had narrowed to 10 pounds per head, the hay wintered calves having gained 8 pounds each more on pasture than the hay and grain wintered calves.

Nitrogen Fertilizer Increases Carrying Capacity of Irrigated Pastures

Ammonium sulphate proved more effective in increasing the carrying capacity of a mixed grass and clover irrigated pasture than treble superphosphate or muriate of potash, when applied at the rate of 100 pounds per acre. Increases in carrying capacity were not indicated from the spring application of treble superphosphate or muriate of potash, but 11 and 20 per cent increases were obtained when ammonium sulphate was used with each of the other fertilizers.

The test areas were grazed with 1,380-pound milking Holstein cows and 885-pound Holstein heifers. The cows averaged about 6.5 years of age, and had been in lactation 97 days at the time the experiment started. Without supplementary feed, the cows produced 1.05 pounds of butterfat per day during the 164-day pasture season and the heifers, averaging about 1.5 years of age, gained 1.35 pounds per day.

Value of Commercial Fertilizer on Alfalfa Doubtful

In the fall of 1936, 3-year-old alfalfa was fertilized, both alone and in various combinations, with sodium nitrate, 125 pounds per acre; treble superphosphate, 125 pounds per acre; muriate of potash, 100 pounds per acre; and gypsum, 200 pounds per acre. The field had been previously fertilized with heavy applications of manure at 4-year intervals. Only one application of fertilizer was made during the four years, 1937-1940 inclusive, when compara-

tive yields were obtained. The results indicate that under the existing conditions of the experiment, no definite economic returns from the use of commercial fertilizer studied were obtained although there were slight increases in yield on the plots to which potassium chloride had been added.

Alfalfa Wilt Tests Completed

Duplicate plots of 16 strains and varieties of alfalfa were planted in 1933 by the Department of Plant Pathology, in an area where alfalfa wilt had been severe. Table 17 gives the results of disease counts made during the month of July, and indicate the per cent of plants surviving after 7 years. Since planting, the plots had been managed in the same manner as alfalfa grown for hay, except that they were grazed by sheep during the fall. As indicated, Turkestan, Ladak, and Hardistan strains gave greatest resistance to bacterial wilt.

Table 17.—Wilt resistance of selected alfalfa varieties and selections as indicated by 7-year test in wilt infected soil

No.	Strain	Per cent stand	No.	Strain	Per cent stand
1.	Norvis	5.0	9.	Turkestan 19304	92.5
2.	Ladak	82.5	10.	Turkestan 19316	92.5
3.	French 19273	7.5	11.	Turkestan 36696	82.5
4.	French 19275	9.5	12.	Turkestan 85751	70.0
5.	Turkestan 19300	90.0	13.	Turkestan 15754	67.5
6.	Turkestan 19301	100.0	14.	North Dakota No. 12	12.5
7.	Turkestan 19302	100.0	15.	Baltic 15989	10.0
8.	Turkestan 19303	82.5	16.	Hardistan 21929	70.0

Sandpoint Branch Station

R. E. KNIGHT, *in charge*

Seeding Burned-Over Land Studied

INVESTIGATIONS dealing with the seeding of burned-over land were undertaken in 1939, following the devastating fire that started in eastern Washington and swept on to cover a large area in adjoining sections of Idaho, particularly in the vicinity of Blanchard and Spirit Lake. The original project, located in Bonner County just outside the city limits of Spirit Lake, consisted of 16 plots of various grasses and legumes, seeded on September 26, 1939. Later, in cooperation with the Soil Conservation Service of the U. S. Department of Agriculture the project was enlarged to include additional grasses. Thirty plots were seeded on November 1, 1939,

and these were duplicated in a third seeding made on April 3, 1940. The final set-up thus included 76 plots involving 32 forage species and employing three seeding dates. Periodic inspections were made during the summer. While the project will be continued as long as necessary, a good deal of information has been gleaned from the first year's work, particularly as regards the species that were able to establish readily and maintain themselves on a drouthy soil during an extremely dry summer. Canada wild rye was the outstanding grass in the September seeding, while crested wheat and slender wheat were both excellent. Big bluegrass, dwarf crested wheat, beardless wheat, and thickspike wheatgrass, none of which were available on the first date, were the outstanding grasses in the late fall and spring seedings. Orchard grass should also be included in this list in the spring-seeded plots. Fortunately, from the standpoint of future seed supply, the better grasses all have good seeding habits. Clovers germinated well, but killed out almost entirely during the dry season. Red top and timothy produced good stands, but burned badly and made scant growth. Owing to the low seed cost and ease of obtaining a stand, timothy doubtless will continue to find a place in the reseeding program where moisture conditions are suitable. As a whole, the fall seedings were looking better than those made the following spring, probably due to the fact that they were better established before the advent of dry weather. The necessity of seeding shortly after a fire—either the same fall or the following spring—was obvious. In spite of the fact that this was an unusually clean burn, a number of grasses, herbs, and shrubs had gained a strong foothold by the following summer. *(See Figure 15.)* Predominating in this group were pine grass, yarrow, mustard, bull thistle, fireweed, Oregon grape, spirea, ocean spray,

Figure 15.—Burned-over land, properly seeded, provides valuable grazing as shown on the left. Fireweed predominates on the unseeded area on the right.

laurel, dogbane, and snowberry. On the plots where good stands of grass were secured, encroachment by other species was largely eliminated.

Crop Yields Boosted by Proper Soil Management

Yield comparisons of the past season, typical of those of previous years, point out the beneficial effects secured through the turning under of a heavy, succulent top growth. In one field, the first crop of alfalfa was plowed under in the spring of 1939, and part of the field seeded to winter wheat that fall. The Athena variety produced 74.8 bushels per acre, and Elgin 78.8 bushels per acre. These are exceptionally good yields for the cut-over soils, and fully twice what might be expected when the customary cropping systems are followed. Potato yields were likewise greatly increased. Chippewa potatoes in this field made a total of 16,027 pounds per acre, while the yield in the rotation, following peas the previous year, was only 6,096 pounds. These yields are computed on the basis of an equal number of hills per acre, thereby putting the plots on a comparable basis and eliminating the factor of stand. Another successful practice has been to drill in winter rye after removing a grain crop, apply 100 pounds per acre of ammonium sulphate that fall or the following spring, turn the rye under at about heading stage, and seed to winter wheat that fall. This system resulted in a yield of 62.7 bushels of Mosida wheat this year, as compared with 30.2 bushels where Mosida followed flax the previous year. A general view of the rotation plots of winter wheat tests is given in Figure 16.

Figure 16.—Rotation plots and winter wheat varieties on the Sandpoint Branch Station.

Elgin Wheat has Desirable Qualities

The need for a special-purpose winter wheat in this locality has been previously mentioned. The need arises from the fact that Mosida, the present leading variety, tends to lodge rather badly when grown on the more fertile soils, particularly during those years when hard winds or rains occur after the grain was headed.

Varietal trials for several years indicate that the Elgin variety has the desired characteristics. It is a white club wheat, a cross of Forty Fold and Hybrid 128, a few days later than Mosida in maturity. It has a shorter, stronger, straw than Mosida, and is, therefore, much more resistant to lodging. Since it is quite susceptible to smut, it would be unwise to grow it in those areas where that disease is a problem. There appears to be no reason for replacing Mosida with Elgin where lodging is not a factor, as the yields are quite comparable. Approximately 9 acres of Elgin were seeded on the Branch Station farm this fall, so that the seed supply for local use next year should be ample.

Borax on Alfalfa Proves Effective

Symptoms of boron deficiency in alfalfa were widespread throughout northern Idaho this year, with the effects being accentuated by the long drouth period. On the Branch Station farm, almost the entire second crop, except for the draws and treated areas, was dwarfed and yellowed. Square-yard samples from this crop disclosed that borax had increased the yield almost 50 per cent. *(See Figure 17.)* Many farmers have become familiar with the symptoms of boron deficiency, and can judge for themselves whether or not their land is adequately supplied. Where a lack of borax is indicated, the recommended rate for alfalfa is 40 pounds per acre not oftener than every 3 years. The borax may be mixed with gypsum to insure a uniform distribution.

Figure 17. — Representative square-yard samples of second-cutting alfalfa from the Sandpoint Branch Station. That on the left was untreated; that on right received 40 pounds of borax per acre.

Treatment Aids in Control of Potato Scab

The project dealing with potato seed treatment employed only the three methods most commonly used here—hot formaldehyde, corrosive sublimate, and New Improved Semesan Bel. The seed used was from a scabby lot, and each seed piece had some scab lesions. The potatoes were treated uncut, and none were presprinkled. The highest percentage of scab occurred in a draw that crossed the plots, and on one end where barnyard liquids had seeped across the rows. All tubers showing any scab lesions what-

ever were classified as "scabby," although many so classified were so slightly affected that the market value was not affected. The results are summarized below.

Treatment	Per cent scab-free	Per cent scabby
Hot Formaldehyde	71.6	28.4
Corrosive Sublimate	62.3	37.7
Check	46.5	53.5
New Improved Semesan Bel	69.3	30.7

High Altitude Branch Station

W. A. Moss, *in charge*

THE High Altitude Branch Experiment Station is located in Teton County on Highway No. 33, 7 miles west of Tetonia. The elevation is 6,200 feet and the average rainfall for the last 21 years has been 12.9 inches. This amount of rainfall is sufficient to produce wheat crops, if the rainfall is properly distributed and there are not too many drying winds. The farm consists of 106 acres of land, all of which is tillable. The Branch Station was moved to its present location in 1939, and all rotation experiments were started at that time. Most of the experimental work deals with problems of the non-irrigated area of the Upper Snake River Valley. Since the Branch Station is located in the region of grain farming, more work has been done with wheat than any of the other crops. However, grasses have entered into the experimental program the last few years.

The principal lines of work at present are: introduction and testing of new varieties of wheat adapted to high altitude and limited moisture conditions, and the increasing and distribution of the better varieties to farmers; rotation experiments in which wheat is the principal cash crop in the rotation; grass experiments in cooperation with the Soil Conservation Service of the U. S. Department of Agriculture; potato projects which include growing of potatoes in the rotation, testing new varieties and strains of potatoes, and the development of clean seed stocks of potatoes for growers; testing of turnips, parsnips, rutabaga, and carrots for seed production, and testing of varieties of sweet corn, squash, and pumpkin for home garden use.

Of the new varieties of spring wheat grown in the uniform nursery the last few years, a selection of White Federation known as White Federation 38, and a hybrid wheat, Baart by Hard Federation, have both yielded well. Baart x Hard Federation is now being grown in field plots and appears to be a good variety.

In 1939, 132 one-tenth acre plots were laid out to test certain rotations and soil management practices designed to sustain the yield of wheat, maintain soil fertility, and prevent loss of soil from wind and water erosion. Crops grown in this rotation are wheat, flax, sweet clover, alfalfa, potatoes, crested wheatgrass, and a mix-

ture containing alfalfa, brome and crested wheat. A very good stand of grasses were obtained in the rotation plots.

Grass experiments in cooperation with the Soil Conservation Service of the U. S. Department of Agriculture include 35 one-tenth acre plots planted with 17 different grasses. These were started in the spring of 1940, and were seeded on a well-prepared seed bed following summer fallow. Good stands of grasses were secured in all cases. Some of the grasses were grown on the old farm and produced seed abundantly. The grass nursery was established in the spring of 1940, in cooperation with the Soil Conservation Service of the U. S. Department of Agriculture. Over 40 grasses and selections of several of the different grasses were included in the nursery. Some of the grasses which are adapted to dry farm pasture mixtures are smooth brome, mountain brome, crested wheatgrass, orchard grass, Michel's grass, and tall meadow oat grass.

Although it is not possible to produce large yields of potatoes on the High Altitude Branch Station due to limited rainfall, there is an opportunity for growing seed plots and testing strains and varieties for use as seed stock. It is hoped that there may be developed disease-free lots of superior strains of seed potatoes which may be used as foundation stock by seed growers. Additional land adjacent to the branch station farm is needed if this project is to be developed adequately.

Availability of Moisture Highly Correlated with Wheat Yields

The yields of both winter and spring wheats obtained at the High Altitude Branch Experiment Station are highly dependent on the availability of moisture. The winter wheat out-yielded the spring wheat by 4.0 bushels over the period of 1920-1940. The average of all varieties of winter wheat grown in the variety test plots over that period amounted to 25.2 as compared to 21.2 bushels of spring wheat for the same period. The yields of winter wheat are determined not only by precipitation received during the growing season, but also by that received during the winter months and during the fallow season preceding the growing of the crop. The yields of spring wheat are influenced by the precipitation occurring during the growing season and during the winter months preceding the seeding of the crop.

In the graphical presentation of the relationship of wheat yields to precipitation, the fallow season is taken to extend from June to October, the winter season from November to April, and the growing season from April to August. With this classification of the season, the average amounts of precipitation received amounted to 5.66 inches for the fallow season and 4.34 inches for the winter months, and 5.11 inches during the growing season. It is evident that the yields of winter wheat are less dependent on precipitation during the growing season than those of spring wheat. Low yields of winter wheat are on record for those years with low moisture

during the fallow and winter seasons, as in 1934 and 1935. High yields of spring wheat are in evidence during years of high winter and high growing season precipitation, as in 1923, 1925, 1928, 1932, and 1938. It is also evident that wheat yields are influenced by factors other than availability of moisture. After all, moisture constituted but one of the numerous factors determining crop response.

Winter injury constitutes the main hazard in the production of winter wheat. The crop may be damaged by direct winter killing or as a result of the fungus disease known as snow scald and caused by *Typhula idahoensis*. In cases where the crop survives the winter, it is in a better relative position to produce high yields than spring wheat, in that it is not as dependent on growing season precipitation; and since it matures earlier than spring wheat, it is more likely to escape August frosts. Spring wheat may be expected to out-yield winter wheat in years when the fall-sown crop is damaged during the winter, and the growing season is favored with an abundance of moisture. Heavy snows have not favored high winter wheat yields and a high degree of damage from snow scald is likely to follow such a winter.

The average yield for 12 years of six of the leading winter wheat varieties in bushels per acre has been: Oro, 25.4; Kharkof, 24.4; Ridit, 24.4; Regal, 24.2; Turkey Red, 23.5; and Kanred, 23.2.

Two of the major needs of the experiment station are a small combine and a good cellar for storing potatoes and other root crops.

Changes in Station Staff Summarized

THERE have been comparatively few changes in the Experiment Station Staff during the year.

Dr. E. M. Gildow, Veterinarian, resigned on February 15, to accept a position with Carnation Milk Farms, Carnation, Washington. Dr. Glenn Holm was transferred from the Department of Bacteriology to assume the position of Veterinarian in the Department of Animal Husbandry. J. B. Rodgers, Assistant Agricultural Engineer, resigned August 20. He was succeeded by Kenneth H. Parks. J. K. Williams, Assistant Poultry Husbandman, resigned August 1, to engage in private business in Texas. J. H. Thompson was appointed to fill this vacancy. Howard Roylance resigned on November 30 as Pea Inspector and Don Corless was appointed to fill the vacancy. George W. Woodbury, Associate Horticulturist, was granted a year's leave of absence October 1, and Charles Y. Arnold was secured to fill the position during Mr. Woodbury's absence. W. E. Colwell, Assistant Agronomist, was granted a year's leave of absence July 1, and Werner L. Nelson was appointed to fill this temporary vacancy.

Publications

THE results of investigations by the Station staff are published as bulletins, research bulletins, circulars, and mimeo-leaflets by the University and as research papers by various scientific journals. The list of publications for 1940 follows:

Bulletins

233. *Alkali Reclamation Investigations.*
234. *Mechanized Dusting Equipment for Pea Weevil Control.*
235. *Transmission of and Resistance to Fowl Paralysis (Lymphomatosis).*
236. *Forty-Seventh Annual Report.*
237. *Idaho Electrified.*
238. *Bean Improvement and Bean Diseases in Idaho.*

Mimeo-Leaflets

43. *Farm Tenancy in Latah County, Idaho, with Special Reference to Leasing Arrangements.*
44. *Rhizopus Rot and Blue Mold Rot of Fruits and Suggestions for Their Control.*
45. *Considerations for Improving the Settlement of the Gravity Unit of the Black Canyon Irrigation Project.*
37. *(Revised) Dormant Sprays for Peach and Apricot.*
46. *Control of Drought Spot and Corky Core of Apples.*
47. *Alfalfa Yellows.*

Research Papers

187. *Some Causes for False Reactions with Whole Blood Pullorum Testing.* G. C. Holm, J. K. Williams, B. F. Callahan, and W. V. Halversen.
188. *Paratyphoid in Chinchilla.* G. C. Holm and P. H. Graves.
189. *The Effect of Protein Absorption on the Base Exchange Capacity of Montmorillonitic Clays.* Leonard E. Ensminger.

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R. E. Knight, B.S.(Agr.), *Superintendent, Sandpoint Branch Station*

HOME STATION DISBURSEMENTS

Detail of Expenditures of State Appropriations[1] and Income Funds
Idaho Agricultural Experiment Station
January 1 through December 31, 1940

	Salaries	Help	Expense & Supplies	Capital Outlay	Total
Administration	$	$ 622.58	$ 1,231.72	$	$ 1,854.30
Agr. Chem.		103.08	806.50	179.06	1,088.64
Agr. Econ.		255.37	601.11	10.00	866.48
Agr. Engr.		156.65	400.23	130.50	687.38
Agron.		1,858.39	1,264.52	1,137.88	4,260.79
An. Hus.		428.74	1,310.17	472.16	2,211.07
Bacter.	846.66	99.75	220.98	313.40	1,480.79
Dairy Hus.		1,045.33	1,922.00	97.14	3,064.47
Entom.		30.80	306.83	760.34	1,097.97
Home Econ.	466.66	55.83	202.98	33.34	758.81
Hort.		438.35	920.05	33.87	1,392.27
Plant Path.		151.03	281.88	8.08	440.99
Poultry	275.00	1,141.02	2,752.50	875.55	5,044.07
Soil Survey		552.49	257.36	59.20	869.05
TOTAL	$1,588.32	$6,939.41	$12,478.83	$4,110.52	$25,117.08

[1] Includes general appropriation and institutional funds.

BRANCH STATIONS DISBURSEMENTS

January 1 through December 31, 1940

	Salaries	Help	Expense & Supplies	Capital Outlay	Total
Aberdeen	$ 3,460.04	$4,062.09	$ 3,424.76	$1,597.47	$12,544.36
Caldwell	3,170.00	2,731.02	4,752.73	1,203.60	11,857.35
High Altitude	1,800.00	439.50	883.36	203.96	3,326.82
Sandpoint	3,079.97	594.50	1,161.17	65.35	4,901.01
TOTAL	$11,510.03	$7,827.11	$10,222.02	$3,070.38	$32,629.54

FINANCIAL STATEMENT

Detail of Expenditures of Federal Appropriations
Idaho Agricultural Experiment Station
July 1, 1939 to June 30, 1940

	Hatch	Adams	Purnell	Bankhead-Jones
Personal services	$ 9,601.24	$11,885.06	$51,033.25	$10,195.48
Supplies and materials	2,171.15	1,701.39	2,920.31	2,217.70
Communication service	599.51	.00	243.43	4.36
Travel expenses	1,266.66	338.59	2,477.42	306.05
Transportation of things	7.40	2.78	96.56	13.51
Printing or duplicating and illustrating publications	791.08	.00	449.18	1.97
Heat, light, water, and power (service and fuel)	4.36	5.84	98.67	.00
Contingent expenses	90.00	4.70	201.72	240.00
Equipment	415.25	1,061.64	2,236.76	110.88
Land (purchase and rent)	.00	.00	.00	.00
Structures and nonstructural improv.	53.35	.00	242.70	628.61
Balance unexpended, June 30, 1940	.00	.00	.00	.00
TOTAL	$15,000.00	$15,000.00	$60,000.00	$13,718.56